

**UTILITY  
PATENT APPLICATION  
TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

862.3050

First Named Inventor or Application Identifier

TSUKASA SAKO, ET AL.

Express Mail Label No.

10675 U.S. PTO  
09/408447**APPLICATION ELEMENTS**

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1. ☒ Fee Transmittal Form  
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3. ☒ Drawing(s) (35 USC 113) Total Sheets **21**
4. ☒ Oath or Declaration Total Pages **2**
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8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney  
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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	67-20 =	47	X \$ 18.00 =	\$846.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	12-3 =	9	X \$ 78.00 =	\$702.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			\$ 260.00 =	\$ 0.00
				BASIC FEE (37 CFR 1.16(a))	\$ 760.00
	Total of above Calculations =				\$2308.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1 28).				
	TOTAL =				\$2308.00

19. Small entity status

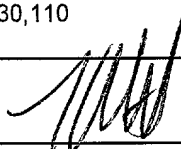
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NAME	Lawrence A. Stahl - Reg. No. 30,110
SIGNATURE	
DATE	September 29, 1999

LAS\SWF\lmj

TITLE OF THE INVENTION  
IMAGE PROCESSING APPARATUS AND METHOD,  
PHOTOGRAPHING SYSTEM,  
CONTROLLING METHOD FOR THE SYSTEM, AND  
5 COMPUTER-READABLE MEMORY

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

10 The present invention relates to an image processing system and a control method for the system, a photographing system and a control method for the system, and a computer-readable memory, which process an image signal obtained by electronically converting an image input and  
15 output the processed signal.

DESCRIPTION OF THE RELATED ART

In a conventional scheme used to obtain a medical X-ray radiographic image for a long time, the distribution of X-rays transmitted through a human body is converted into  
20 a fluorescence distribution of a phosphor, the light intensity is directly printed on a film, and the film is developed. In recent years, a radiographic image is read out as an electrical signal using a scheme of forming a latent image of an X-ray intensity distribution as an energy  
25 on a photostimulable phosphor and reading out the image, a scheme of directly reading the fluorescence distribution

of a phosphor by X-rays as an image, or a technique without use of a fluorescence distribution. The electrical signal is converted into digital data to form a digital image. Use of digital images allows efficient filing, practical use  
5 of remote diagnosis, and improvement of the diagnostic technology and efficiency. In addition, digital images make various image processing operations possible and are also changing the diagnosis method.

Under these circumstances, as disclosed in Japanese  
10 Patent Laid-Open No. 09-098970 proposed by the present applicant, an X-ray image sensing apparatus using a wide-screen two-dimensional solid-state image sensing device has been provided. An X-ray detection apparatus capable of detecting an X-ray radiographic image larger  
15 than a conventional regular size film can be manufactured.

Generally, a film used to photograph an X-ray image of a thoracic or abdominal portion has a half size (14" x 17") or a large size (14" x 14"). As for the direction of a film in photographing, a film with half size is generally  
20 set long in the vertical direction (so-called portrait). Sometimes, an image to be photographed does not completely fall within the film area depending on the height or form of the person to be examined. When the image to be  
25 photographed stretches out in the vertical direction, the person to be examined must vertically move to acquire a photographed image. In this case, X-rays are radiated

twice to acquire a photographed image, resulting in an increase in X-ray dose for the person to be examined. When the image to be photographed stretches out in the horizontal direction, the person to be examined must move in the horizontal direction to photograph the image twice. Alternatively, a horizontally elongated film (so-called landscape) as shown in Fig. 3 is used to acquire a photographed image. When the to-be-photographed image of the person to be examined does not fall within the film area, the X-ray dose for the person to be examined increases. Additionally, the operation becomes cumbersome because, e.g., the direction of the X-ray detection apparatus need be changed from portrait to landscape.

The sensor area of a digital X-ray sensing apparatus may be larger than a film screen system. For example, the CXDI (trademark) available from Canon has a size of 17" (43 cm) x 17" (43 cm). Commercially available films have only predetermined sizes: 14" x 17", 14" x 14", or 10" x 12". Hence, to print an image on a commercially available film, the area to be extracted from a 17" x 17" image, and the film to be used must be carefully selected.

On the other hand, for many commercially available image viewers, allowable image sizes are predetermined. Especially, the maximum size is often predetermined. For commercially available diagnostic viewers, the maximum allowable size of an image is 2,048 x 2,048 pixels. Hence,

even when an image is to be output to a medium other than a film, the same problem as for a film is posed.

#### SUMMARY OF THE INVENTION

5       The present invention has been made in consideration of the above situation, and has as its object to provide an image processing system and a control method for the system, a photographing system and a control method for the system, and a computer-readable memory, which can  
10 efficiently photograph without any increase in X-ray dose for a person to be examined.

      In order to achieve the above object, according to the present invention, there is provided an image processing system for processing an image signal obtained  
15 by electronically converting an input image and outputting the image signal, comprising:

      output mode input means for inputting an output mode representing an output format of an observation area as a to-be-output area in the image to an output medium;

20       input means for inputting a size of an effective image area of the output medium; and

      determination means for determining an output method of the observation area on the basis of the observation area and contents input by the output mode input means and the  
25 input means.

      It is another object of the present invention to make

it possible to output an image while selecting an appropriate output size from a plurality of predetermined output sizes in accordance with the to-be-output portion of the image to be output, and appropriately output the image to an existing medium or viewer without damaging the information.

In order to achieve the above object, according to the present invention, there is provided an image processing apparatus comprising:

10 acquisition means for specifying a to-be-output area of an image represented by image data as an output image and acquiring a size of the output image;

selection means for selecting, on the basis of the size of the output image acquired by the acquisition means, one image output size from a plurality of types of image output sizes set in advance;

layout determination means for determining a layout of the output image in an output area having the image output size selected by the selection means;

20 display means for displaying on the basis of a layout state determined by the layout determination means; and

change means for changing the layout state of the output image in the output area in accordance with an instruction for changing the layout state displayed by the display means.

Other features and advantages of the present invention

will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view showing the schematic arrangement of a digital X-ray photographing system according to the first embodiment of the present invention;

10 Fig. 2 is a view showing a portrait film with a regular size in the first embodiment of the present invention;

Fig. 3 is a view showing a landscape film with a regular size in the first embodiment of the present invention;

15 Fig. 4 is a view showing an X-ray detection apparatus according to the first embodiment of the present invention;

Fig. 5 is a block diagram showing the functional arrangement of the digital X-ray photographing system according to the first embodiment of the present invention;

20 Fig. 6 is a flow chart showing processing executed by the output determination section of the first embodiment of the present invention;

Fig. 7 is a view showing an observation area in the first embodiment of the present invention;

25 Fig. 8 is a view showing the effective image area of the portrait film in the first embodiment of the present



invention;

Fig. 9 is a view showing the effective image area of the landscape film in the first embodiment of the present invention;

5 Fig. 10 is a view for explaining an example of determination of a film to be used for output in the first embodiment of the present invention;

10 Fig. 11 is a view showing an example of image formation on the landscape film in the first embodiment of the present invention;

Fig. 12 is a view for explaining an image switching output mode in the first embodiment of the present invention;

15 Fig. 13 is a view for explaining the image switching output mode in the first embodiment of the present invention;

Fig. 14 is a view for explaining a 2-image output mode in the first embodiment of the present invention;

20 Fig. 15 is a block diagram showing the functional arrangement of a digital X-ray photographing system according to the second embodiment of the present invention;

25 Fig. 16 is a view for explaining the procedure of acquiring observation area setting information in the third embodiment of the present invention;

Fig. 17 is a view for explaining the procedure of

acquiring observation area setting information in the third embodiment of the present invention;

Fig. 18 is a block diagram showing the functional arrangement of a digital X-ray photographing system according to the third embodiment of the present invention;

Fig. 19 is a block diagram showing the arrangement of an X-ray imaging apparatus;

Fig. 20 is a block diagram for explaining irradiation field area layout and sensor position marking processing;

Fig. 21 is a view showing an example of layout of an irradiation field area;

Fig. 22 is a view for explaining output sizes set in advance;

Fig. 23 is a view for explaining an irradiation field;

Fig. 24 is a view for explaining processing of reducing the range of the irradiation field area;

Fig. 25 is a view for explaining processing of limiting the irradiation field area by an operator;

Fig. 26 is a view for explaining sensor position marking by a sensor position marking section;

Fig. 27 is a view showing an example of reduction marking;

Fig. 28 is a flow chart showing processing by an irradiation field area layout calculation section;

Fig. 29 is a view for explaining outstretch margin

calculation of the fourth embodiment; and

Figs. 30A to 30C are views for explaining a display scheme of a display section 1206.

5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be described below with reference to the accompanying drawings.

<First Embodiment>

10 Fig. 1 is a view showing the schematic arrangement of a digital X-ray photographing system according to the first embodiment of the present invention.

Referring to Fig. 1, an X-ray source 101 generates X-rays. An X-ray control apparatus 112 controls the tube voltage or tube current of a radiation tube for generating  
15 ray. X-rays 115 generated by the X-ray source 101 pass through a person 102 to be examined as a diagnosis object and enter an X-ray detection apparatus 103. At this time, the X-rays 115 pass through the person 102 to be examined  
20 and become incident on a phosphor 113 for converting the X-rays 115 into visible light. The X-rays 115 that have passed through the person 102 to be examined contain image information with different transmission amounts according to the sizes or shapes of bones and viscera or the  
25 presence/absence of a morbid portion in the person 102 to be examined. The X-rays 115 are converted into visible

light by the phosphor 113 and enter an X-ray image sensing section 114. The X-ray image sensing section 114 as an example comprises a plurality of photoelectric conversion elements arrayed in the row and column directions. The  
5 X-ray image sensing section 114 converts image information light into an electrical signal, stores the signal, and outputs it as a digital image signal via an A/D converter 116. The image sensing time and driving method for the X-ray image sensing section 114 are controlled by a control  
10 apparatus 104 through a control line 111.

The digital image signal output from the A/D converter 116 is transferred to the control apparatus 104, subjected to predetermined image processing, and displayed on a simple image display apparatus 105. When examination  
15 is ended, the image which has undergone predetermined image processing is transferred to a laser imager 107 or a CRT diagnostic image processing workstation 108 via a network 106. The image transferred to the laser imager 107 is formed on a film using a laser beam and developed. The image  
20 transferred to the CRT diagnostic image processing workstation 108 is displayed on a portrait high-definition monitor 109 or a landscape high-definition monitor 110 together with an examination number, the name and date of birth of the person examined, and the like.

25 The relationship between a film and the X-ray detection apparatus 103 used in the first embodiment will

be described next with reference to Figs. 2 to 4.

Fig. 2 is a view showing a portrait film with a regular size in the first embodiment of the present invention. Fig. 3 is a view showing a landscape film with a regular size in the first embodiment of the present invention. Fig. 4 is a view showing the X-ray detection apparatus according to the first embodiment of the present invention.

The X-ray detection apparatus 103 shown in Fig. 4 has a sufficiently larger size than the regular size of a portrait film 201 shown in Fig. 2 and that of a landscape film 202 shown in Fig. 3. The laser imager 107 cannot form an image in the entire area of a film. Generally, the laser imager 107 can form an image only in an area (effective image area) smaller than the film size. When the portrait film 201 has a width  $XP$  and a height  $YP$ , the landscape film 202 has a width  $XL$  and a height  $YL$ , and the X-ray detection apparatus 103 has a width  $XS$  and a height  $YS$ ,  $XP \leq XS$ ,  $XL \leq XS$ ,  $YP \leq YS$ , and  $YL \leq YS$ .

The functional arrangement of the digital X-ray photographing system according to the first embodiment will be described next with reference to Fig. 5.

Referring to Fig. 5, after radiation of X-rays, an image input section 301 acquires digital image data in the entire effective image area of the X-ray detection apparatus 103. The X-ray detection apparatus 103 may acquire, from a storage medium such as a hard disk, the

digital image data in the effective image area, which has  
already been acquired from the X-ray detection apparatus  
103. An observation area setting section 302 sets  
observation area setting information as information  
5 associated with an observation area to be displayed on an  
output medium such as a film. This observation area setting  
information is set using X-ray irradiation stop information  
obtained from the X-ray control apparatus 112, and then  
transferred from the X-ray control apparatus 112 to the  
10 control apparatus 104.

An image processing section 304 executes  
predetermined image processing. Various image processing  
operations such as gray-level processing or frequency  
processing suitable for observation by a doctor are  
15 performed. An output mode input section 307 inputs an  
output mode such that a life-size (actual size) image is  
output, an image is reduced and output, a life-size image  
is segmented into a plurality of films and output, or only  
one image is output by image extraction. An output medium  
20 size input section 303 inputs the size of the effective  
image area of the currently selected film. Since a portrait  
film and a landscape film may have different effective image  
area sizes, the size of the effective image area of each  
film is input. Although the output medium size input  
25 section 303 inputs the size of the effective image area of  
the film, the effective image area of the film may be

acquired from the laser imager 107 via the network 106 online.

An output determination section 305 determines how to output the digital image data input by the image input section 301, on the basis of the contents input by the output mode input section 307 and output medium size input section 303. On the basis of the determination result of the output determination section 305, an image transfer section 306 transfers the digital image data to the laser imager 107 or CRT diagnostic image processing workstation 108.

Processing executed by the output determination section 305 of the first embodiment will be described next with reference to Fig. 6.

Fig. 6 is a flow chart showing processing executed by the output determination section of the first embodiment of the present invention.

In step S401, an aspect ratio  $R$  of an observation area represented by observation area setting information set by the observation area setting section 302 is obtained. When the observation area has a width  $XR$ , a height  $YR$ , and the aspect ratio  $R$ , the aspect ratio  $R = YR/XR$ . When the aspect ratio  $R$  of the observation area is larger than 1.0, it is determined that the observation area is vertically elongated. When  $R < 1.0$ , it is determined that the observation area is horizontally elongated. When  $R = 1.0$ , it is determined that the observation area is square.

In step S402, using the size of the effective image area of the film, which is input by the output medium size input section 303, it is determined whether the observation area falls within the effective image area of the film. For  
5 either a portrait film or a landscape film, it is determined whether the observation area falls within the effective image area of the film. If the observation area falls within the effective image area (YES in step S402), the flow advances to step S407 to output a life-size image on the  
10 film in the direction based on the aspect ratio R of the observation area.

More specifically, when an area 501 indicated by the dotted line in Fig. 7 is set by the observation area setting section 302 as the observation area, the hatched portion  
15 shown in Fig. 8 corresponds to the effective image area of a portrait film. The hatched portion shown in Fig. 9 corresponds to the effective image area of a landscape film. For the observation area 501 shown in Fig. 7, the aspect ratio R of the observation area is larger than 1.0, and an  
20 image is output using the portrait film shown in Fig. 8.

When an area indicated by the dotted line in Fig. 10 is set by the observation area setting section 302 as the observation area, the aspect ratio R of the observation area is smaller than 1.0, and an image is output using the  
25 landscape film shown in Fig. 11.

When it is determined in step S402 that the



observation area does not fall within the effective image area of the film (NO in step S402), the flow advances to step S403 to confirm the output mode set by the output mode input section 307. In the first embodiment, it is

5 determined in step S403 whether a 2-image output mode is set. In addition, it is determined in step S405 whether an image extraction output mode is set.

When the 2-image output mode is not set (NO in step S403) and the image extraction output mode is not set (NO  
10 in step S405), i.e., when the 1-image output mode and the reduction output mode are set, the image is reduced and output such that the observation area falls within the effective image area of the film in step S408.

Assume that the 2-image output mode is not set (NO  
15 in step S403) and the image extraction output mode is set (YES in step S405), i.e., the 1-image output mode and the life-size output mode are set. In this case, in step S406, the film to be used is determined on the basis of the aspect ratio  $R$  of the observation area, and an image portion that  
20 falls outside the effective image area of the film is extracted using, as a reference, the center of the effective image area of the film and the center of the observation area. In step S407, the extracted life-size image is output. In the example shown in Fig. 12, the image portion between  
25 the right boundary line of the effective image area and the right boundary line of the observation area and that between

the left boundary line of the effective image area and the left boundary line of the observation area are extracted in step S406. In the example shown in Fig. 13, the image portion between the lower boundary line of the effective image area and the lower boundary line of the observation area is extracted in step S406.

In the first embodiment, an image portion that falls outside the effective image area is extracted using, as the reference, the center of the effective image area of the film. However, the reference is not limited to the center of the effective image area. Various positions can be set as the reference to shift the effective image area to the upper or lower side or the left or right side. This reference can be set by the output mode input section 307.

When the 2-image output mode is set (YES in step S403), in step S404, using films determined on the basis of the aspect ratio R of the observation area, the overlap portion of the effective image areas of the films is calculated. The output ranges of images to be output to the two films are determined on the basis of the overlap portion. In step S407, images within the determined output ranges are output to the two films, respectively. Fig. 14 shows the 2-image output mode using portrait films. In this example, the overlap portion of the effective image areas is calculated from the image output range obtained by aligning the effective image area of one film to the right boundary line

of the observation area and that obtained by aligning the effective image area of the other film to the left side of the observation area.

In the processing described with reference to Fig. 6,  
5 it is determined whether the output mode is the 2-image output mode. When the X-ray detection apparatus 103 is much larger than the effective image area of a film, not the 2-image output mode but a multi-image output mode for outputting three or more images may set to output images.

10 As described above, according to the first embodiment, in the digital X-ray photographing system having the X-ray detection apparatus 103 larger than the regular size of a film as the output medium, even when the image of the person to be does not fall within the regular-size film, an image  
15 corresponding to the entire observation area can be output by one cycle of exposure in accordance with the set output mode, so the X-ray dose for the person to be examined can be reduced. In addition, since the technician as the operator of the X-ray photographing system need not  
20 exchange the X-ray detection apparatus to an apparatus with the same size as the regular size of a film or change the direction of the film, the entire examination time can be shortened.

#### <Second Embodiment>

25 In the first embodiment, the observation area setting information is set by the observation area setting section

302 using the X-ray irradiation stop information obtained from the X-ray control apparatus 112. However, this is not always necessary. For example, as shown in Fig. 15, on the basis of digital image data acquired by an image input  
5 section 801, an irradiation field recognition section 802 automatically acquires an area where an X-ray detection apparatus 103 is irradiated with X-rays, and determines the area as an observation area. The processing described in the first embodiment is executed for this observation area.  
10 As the irradiation field recognition section 802, for example, a method disclosed in Japanese Patent Application No. 10-243020 proposed by the present applicant can be applied.

The image input section 801, an image processing  
15 section 804, output mode input section 807, output medium size input section 803, output determination section 805, and image transfer section 806 correspond to the image input section 301, image processing section 304, output mode input section 307, output medium size input section 303,  
20 output determination section 305, and image transfer section 306 of the first embodiment shown in Fig. 5, respectively, and the functions thereof are the same as described in the first embodiment.

As described above, according to the second  
25 embodiment, even when X-ray irradiation stop information cannot be acquired from the X-ray control apparatus 112,

the same effect as described in the first embodiment can be obtained by using the irradiation field recognition section 802.

<Third Embodiment>

5           In the first embodiment, the observation area setting information is set by the observation area setting section 302 using the X-ray irradiation stop information obtained from the X-ray control apparatus 112. However, this is not always necessary. For example, as shown in Fig. 18,  
10   observation area setting information may be obtained by setting portion information input from a to-be-photographed portion input section 1006. An observation area extraction section 1002 automatically extracts the basic observation area for the doctor from that  
15   portion. An observation area is set on the basis of the basic observation area, thereby obtaining the observation area setting information. Figs. 16 and 17 show this example. Fig. 16 shows the front image of a chest. Fig. 17 shows the side image of the chest. In both cases,  
20   an area (an area indicated by a thin dotted line) including the area of lungs is the basic observation area for the doctor. This basic observation area is extracted by the method described in, e.g., Hasegawa, Toriwaki, and Fukumura, "Software System AISC-R-V3 for Automatically Screening  
25   Indirectly Photographed Thoracic Radiograph", IEICE Transactions J66-D10, (1983). In this method, after the

area of lungs is roughly extracted, the circumscribed rectangular area of the lung area is extracted as the basic observation area. After that, the area is enlarged by N (N is a non-integer) using the center of the basic observation area as a reference, thereby acquiring an observation area (indicated by a bold dotted line). The processing described in the first embodiment is performed for this observation area.

An image input section 1001, image processing section 1003, output mode input section 1007, output medium size input section 1008, output determination section 1004, and image transfer section 1005 correspond to the image input section 301, image processing section 304, output mode input section 307, output medium size input section 303, output determination section 305, and image transfer section 306 of the first embodiment shown in FIG. 5, respectively, and the functions thereof are the same as described in the first embodiment.

As described above, according to the third embodiment, the basic observation area is automatically extracted in accordance with the portion to be photographed, and the observation area is set on the basis of the basic observation area. Unlike the first and second embodiments in which the observation area is obtained on the basis of the X-ray irradiation stop information, a necessary minimum area can be acquired without missing the area necessary for

the doctor's diagnosis. Hence, a smaller output medium such as a film can be selected to reduce running cost.

As has been described above, according to the above embodiments of the present invention, an image processing system and a control method for the system, a photographing system and a control method for the system, and a computer-readable memory, which can efficiently photograph without any increase in the X-ray dose for the person to be examined, can be provided.

#### 10 <Fourth Embodiment>

In the fourth embodiment, the image processing apparatus of the present invention is applied to an X-ray imaging apparatus.

FIG. 19 is a block diagram showing the arrangement of the X-ray imaging apparatus. The operator sets an object 1100 to be photographed between a solid-state image sensing element 1101 and an X-ray tube 1102. Next, the operator selects the portion to be photographed using a user interface (the user interface is constructed by a display IF section 1119, display 1120, and keyboard and mouse 1121). With this operation, the object setting style, i.e., PS photographing (X-rays are radiated from the backside to the front) and AP photographing (X-ray are radiated from the front to the backside) is instructed. Simultaneously, an imaging control section 1113 applies a voltage to the solid-state image sensing element 1101 using a solid-state

image sensing element drive control signal, thereby preparing for image input to the solid-state image sensing element 1101.

5 The operator moves the X-ray tube 1102 to a position separated from the solid-state image sensing element 1101 by an appropriate distance. At this time, the distance (distance signal) between the solid-state image sensing element 1101 and the X-ray tube 1102 is input from a distance measurement section 1106 to the imaging control section 10 1113.

The operator adjusts the X-ray stop-down amount using a stop instruction section 1108 such that the to-be-photographed portion of the object is captured. Stop signal 1 from the stop instruction section 1108 is 15 transmitted to the imaging control section 1113, stop signal 2 to an X-ray generation apparatus control section 1109, and stop signal 3 to an X-ray stop 1105 to control its opening/closing degree. The X-ray stop 1105 has a rectangular shape. The open/close amount of the X-ray stop 20 1105 can be adjusted in both the vertical and horizontal directions. Whether the portion of the object 1100 is appropriately illuminated through the X-ray stop 1105 can be determined using lamp light.

A radiation button 1110 serves as a trigger for 25 causing the X-ray tube 1102 to generate X-rays. Radiation signal 1 generated by the radiation button 1110 is



temporarily input to the imaging control section 1113 in  
an imaging apparatus 1111. The imaging control section  
1113 confirms whether the solid-state image sensing element  
1101 is ready for forming an image of input X-rays, on the  
5 basis of a drive notification signal from the unit including  
the solid-state image sensing element 1101, and then  
generates a radiation enable signal. The radiation enable  
signal turns on a radiation enable switch 1114 to connect  
radiation signal 1 to radiation signal 2. The radiation  
10 signal is generated using the second switch of the radiation  
button (the radiation button of the X-ray generation  
apparatus constitutes a two-stroke switch: a voltage is  
applied to the X-ray generator at the first stroke position  
(first switch), and X-rays are radiated at the second stroke  
15 position (second switch)).

Radiation signal 2 is input to the X-ray generation  
apparatus control section 1109. As soon as the apparatus  
becomes ready for radiating X-rays, the X-ray generation  
apparatus control section 1109 outputs radiation signal 3  
20 to cause the X-ray tube 1102 to generate X-rays. The  
transmitted rays of the radiated X-rays are input to the  
solid-state image sensing element 1101 through a grid 1104  
and scintillator 1103 as an image.

The solid-state image sensing element 1101 generates  
25 an electrical signal corresponding to this image. This  
signals is read out, converted into a digital signal by an

A/D converter 1107, and transferred to the imaging control section 1113. The imaging control section 1113 is managed by a CPU 1112. The CPU 1112 is connected, via a bus, to not only the imaging control section 1113 but also a RAM 1115, ROM 1116, LAN/IF 1117, DISK/IF 1118, nonvolatile memory device 1122, and user IF section 1119.

In this embodiment, a hard disk is used as the nonvolatile memory device 1122. The user IF section 1119 has the display 1120 and keyboard and mouse 1121 to interface with the user. The image (digital image) input from the A/D converter 1107 to the imaging control section 1113 is temporarily stored in the RAM 1115 and subjected to various processing operations (to be described later) by the CPU 1112.

Fig. 20 is a block diagram for explaining irradiation field area layout and sensor position marking processing. Processing shown in Fig. 20 is realized when the CPU 1112 executes a control program stored in the ROM 1116.

An irradiation field recognition section 1201 recognizes the irradiation field of the photographed image and calculates the irradiation field area. Various methods can be used to recognize the irradiation field. For example, the method proposed in Japanese Patent Application No. 10-243020 by the present applicant can be used. This will be briefly described. With an arrangement comprising a calculation means for calculating the first derivative

of the gray-scale value representing each two adjacent areas of three parallel square areas and calculating the second derivative from the calculated first derivative, a calculation area determination means for determining the three square areas, a storage means for storing the second derivative calculated by the calculation means, and a determination means for determining one end point of an irradiation area from the second derivative stored in the storage means, an irradiation area is easily and accurately extracted from a radiographic image. When the irradiation field is recognized by the irradiation field recognition section 1201, the recognition result (irradiation field area information) is supplied to a display image processing section 1202.

On the basis of the irradiation field area information from the irradiation field recognition section 1201, the display image processing section 1202 processes the image such that appropriate contrast is set within the irradiation field area. For example, data is decimated to generate a reduced display image. This processing is not directly associated with this embodiment, and a detailed description thereof will be omitted.

The irradiation field area information representing the irradiation field recognition result from the irradiation field recognition section 1201 is also supplied to an irradiation field area layout calculation section

1203. The irradiation field area layout calculation section 1203 calculates the irradiation field area layout on the basis of some output sizes set in advance. The algorithm of calculation will be described later. In the  
5 output from the irradiation field area layout calculation section 1203, the irradiation field area of the original photographed image falls within the selected output size.

Fig. 21 is a view showing an example of layout of the irradiation field area. Referring to Fig. 21, the large  
10 size (35-cm square) is selected as the output size (film area), and the irradiation field area is laid out within the output size.

Fig. 22 is a view for explaining output sizes set in advance. In this embodiment, five designated sizes are  
15 prepared, as shown in FIG. 22. The irradiation field area layout calculation section 1203 selects an appropriate one of the output sizes. For example, referring to Fig. 21, the large size is selected from these designated sizes. This size is optimum because an excess area becomes large  
20 in a larger film size, and the irradiation field area does not fall within a smaller film size.

Note that, in Figs. 21 and 22, the number of pixels is accurate. However, the values with units of "inch" and "centimeter" are not accurate.

25 Referring back to Fig. 20, the irradiation field area layout calculation section 1203 calculates the layout of

the irradiation field area in the designated size. The calculation result is supplied to a display image rotation/reversal section 1204. The display image rotation/reversal section 1204 rotates/reverses the reduced display image on the basis of a rotation/reversal value instructed at the time of photographing. For example, as shown in Fig. 26, when the operator photographs the object in the PA photographing mode (from the backside to the front), and the photographed image is simply displayed, the image is reversed, unlike an image normally observed by a doctor. For example, the heart is displayed on the left side. Hence, in PA photographing, the image must be reversed and then displayed. Rotation processing is done to correct a vertically inverted image because an image may be inverted in the vertical direction depending on the direction of the head of the to-be-examined person on the bed. Since the PA and AP photographing modes are used even on a bed, reversal processing is necessary due to the same reason as described above.

20       The display image rotation/reversal section 1204 must convert the coordinate system in consideration of the reduction ratio for display and rotation/reversal even for irradiation field area layout coordinates. The conversion result is transmitted to an overlay section 1205.

25       The overlay section 1205 displays a rectangle based on the irradiation field area layout coordinates reduced,

rotated, and reversed, which is overlaid on the reduced display image rotated and reversed. The image is displayed on a display section 1206. This display will be described later with reference to Fig. 30.

5           When the irradiation field area layout calculation section 1203 cannot set the entire irradiation field area within the maximum output size, the operator is notified that the irradiation field area does not fall within the output size. In this embodiment, the display section 1206  
10 displays a warning message. In this case, the operator can take one of the following three solutions.

(1) The image in the irradiation field area is reduced such that the irradiation field area falls within the maximum output size. In this case, the image is output not  
15 in life size but in a smaller size. Fig. 23 is a view for explaining reduction of the irradiation field. A film area 1501 indicated by the broken line in Fig. 23 is expressed to be large relative to an irradiation field area 1503. In actual processing, the irradiation field area 1503 is  
20 reduced such that it falls within the film area 1501, so the film output has a size smaller than life size. A sensor area 1502 is the area of the solid-state image sensing element 1101 where an image can be input.

(2) The range of the irradiation field area is  
25 restricted such that the range falls within the film area. Fig. 24 is a view for explaining reduction of the range of

the irradiation field area. With this processing, as shown in Fig. 24, those portions of an irradiation field area 1603 which protrude from a film area 1601 are excluded as excluded portions 1604.

- 5           (3) The operator designates a limited irradiation field area. Fig. 25 is a view for explaining limitation of the irradiation field area by the operator. In this case, the operator points, with the mouse, diagonal vertices of a rectangle to be set as an irradiation field area.
- 10 Referring to Fig. 25, when the operator points two positions indicated by x, an irradiation field area 1703 is determined. This irradiation field area 1703 is used in place of the irradiation field area obtained by the irradiation field recognition section 1201. That is, when
- 15 the operator designates the irradiation field area 1703 smaller than a film area 1701, normal processing is performed. In this example, a large size including the irradiation field area 1703 is designated. To designate the size, a size with a minimum residual is automatically
- 20 selected.

The above change in layout processing is designated to the irradiation field area layout calculation section 1203 using an instruction section 1207 (the display IF section 1119 in this case) to achieve the exceptional

25 operation.

Sometimes although the operator has photographed the

object in the PA (from the backside to the front)  
photographing mode, the object must be photographed in the  
AP (from the front to the backside) photographing mode in  
actually determining the direction of the patient because  
5 of his/her condition of the disease. In this case, the  
image must be reversed after photographing. The  
instruction section 1207 can instruct the display image  
rotation/reversal section 1204 to reverse or rotate  
(rotation/reversal change) the image. Upon receiving the  
10 rotation/reversal change instruction, the display image  
rotation/reversal section 1204 rotates or reverses the  
image in accordance with the instruction and re-displays  
the image.

When the operator appreciates the image layout  
15 finally, the layout calculation is determined. Two  
methods can be used to do this. The operator explicitly  
inputs an instruction from the instruction section 1207,  
or the time is out before the operator inputs an instruction.  
In this embodiment, both the methods are implemented. The  
20 time-out time is one minute.

When the layout calculation is determined, the  
photographed image, layout coordinate determination values,  
and rotation/reversal determination values are stored in  
the nonvolatile memory device 1122 (hard disk in this  
25 embodiment) by a temporary storage section 1208. The  
photographed image is the image data input through the A/D



converter 1107. The layout coordinate determination values represent the position of the irradiation field area relative to the film area. The rotation/reversal determination values are the rotation and reversal values of the image, which are determined by the display image rotation/reversal section 1204. The photographed image, layout coordinate determination values and the like are read out again for processing. This processing is performed as background processing.

10 Background processing is performed due to the following reason. Since the processing described above is performed using a reduced image mainly on the basis of logic calculation, the calculation time is relatively short. However, calculation for processing to be described below is done to, e.g., process the entire photographed image having a large size of 2,688 x 2,688 pixels, and takes a long time. During this processing, the user cannot start the next photographing operation. That is, when the processing is performed on the background, the operator can quickly start the next photographing cycle. Hence, processing from an extraction section 1209 to be described below is executed on the background.

The extraction section 1209 extracts a portion from the photographed imaging out from the nonvolatile memory device 1122 on the basis of the layout coordinate determination values read out from the nonvolatile memory

device 1122. With this processing, the photographed image is trimmed in accordance with the layout coordinate determination values. As a result, a partial image of the irradiation field area is extracted from the photographed image.

The photographed image is appropriately processed by an image processing section 1210 to have appropriate contrast for diagnosis. After that, the photographed image is sent to a sensor position marking section 1211.

The sensor position marking section 1211 is used as a remedy when the designated rotation/reversal designation values have errors. For example, a remedy is required in the following case. Although the operator sets the PA (from the backside to the front) photographing mode, it may become apparent in actually determining the direction of the patient that the object need be photographed in the AP (from the front to the backside) photographing mode because of his/her condition of the disease. In such case, after the object is photographed, the operator may also forget to instruct the display image rotation/reversal section 1204 to reverse the image. Then, the image which must be reversed cannot be discriminated from the image normally photographed in the PA mode. This is because the film can be observed from both sides.

Fig. 26 is a view for explaining sensor position marking by the sensor position marking section. As shown

in Fig. 26, after the image is extracted by the extraction section, the upper left position of the sensor is marked at the upper left corner of the image, which corresponds to the upper left portion of the sensor. Even when the image  
5 is rotated or reversed, the photographing direction of the image can be known. Since the sensor position is marked after extraction, the mark is not eliminated by extraction.

The marking information of the upper-left position of the sensor need not be always actually written in the  
10 image. Instead, information representing an image corner corresponding to the upper left portion of the sensor may be added to the header of the image data. In this case, especially when the final image is to be sent to a printer or a viewer, the receiving device must read and interpret  
15 this header information.

After sensor position marking, the image data is input to a rotation/reversal section 1212. The rotation/reversal section 1212 rotates and reverses the image in accordance with the stored rotation/reversal  
20 determination values. The processed image data is input to a reduction marking section 1213.

The reduction marking section 1213 marks to make it clear that the irradiation field area is reduced within the film to form a life-size image or less, as described with  
25 reference to Fig. 23. This reduction marking is necessary only when the output medium is a printer or a laser imager.

Many laser imagers have a function of printing a life-size image or less on the laser imager side without reducing the output image. In this embodiment, image reduction is not performed because it depends on such a laser imager.

This will be described in detail. The pixel size of the sensor of this embodiment is  $160\text{ }\mu\text{m}$ . When an extracted image having a size of  $2,048 \times 2,560$  pixels is to be sent to a laser imager with a size of  $80\text{ }\mu\text{m}$ , an instruction for interpolating and enlarging the image to 2x is sent together. The laser imager interpolates and enlarges the image to 2x, so an image having a size of  $4,096 \times 5,120$  pixels is output. This size is life size.

When the entire sensor area is explicitly selected by the operator for printing, the size is  $2,688 \times 2,688$  pixels. In a printer with a size of  $80\text{ }\mu\text{m}$ , which has a buffer area with a size of  $4,096 \times 5,120$  pixels, the magnification of the image is limited by the magnification in the horizontal direction. That is,

$$4096/2688 = 1.523$$

The image can be printed by interpolation and enlargement at the maximum magnification of about 1.523x. Hence, the image is transferred together with an instruction for the magnification of 1.523x. In terms of data, this processing is enlargement. However, when viewed from the operator, the output size is smaller than life size, and therefore,

this processing is life-size reduction. Fig. 27 is a view showing an example of reduction marking. Referring to Fig. 27, reference numeral 1901 denotes reduction marking clearly representing that the image is reduced. After that,  
5 the image is externally output through an output section.

Processing by the irradiation field area layout calculation section 1203 will be described next. Fig. 28 is a flow chart showing processing by the irradiation field area layout calculation section.

10 In step S11, irradiation field area information representing the irradiation field area of the photographed image is input from the irradiation field recognition section 1201. In step S12, the vertical length of the recognized irradiation field area is compared with the  
15 horizontal length. If the vertical length is larger, A is the vertical direction, and B is the horizontal direction (step S13). If the horizontal length is larger, A is the horizontal direction, and B is the vertical direction (step S14).

20 In step S15, a variable I is initialized. This variable I is used to check a table which records designated sizes in advance. In this embodiment, the table shown in Fig. 22 is used. This table can be registered by the operator in advance as initial setting. That is, the  
25 operator can register desired designated sizes in advance.

In step S16, from the layout classification A in the

table shown in Fig. 22 (when the irradiation field area is vertically elongated, the layout classification "vertical" is selected in Fig. 22), the Ith size counted from a small number of pixels in the A direction is selected (at the first time processing of this step, the first size is selected). If the number of pixels in the A direction is the same, the number of pixels is selected in ascending order in the B direction. The vertical and horizontal sizes are used as indices in the table, and sizes are arranged in descending order in each index. For the same size, when the layout classification is "vertical", sizes are arranged in the order of horizontal sizes. When the layout classification is "horizontal", the sizes are arranged in the order of vertical sizes (For example, when A is the vertical direction (layout classification is "vertical"), sizes are searched in ascending order of vertical sizes. The smallest size is "1/4-size portrait". The second smallest size is "large-size" and "half-size portrait"). However, when the number of pixels in the horizontal direction is taken into consideration, the second smallest size is "large-size").

In step S17, it is determined whether the Ith size is selected in step S16. In processing of step S16 and steps S18 to 21 to be described below, the variable I is incremented by one until an appropriate size is acquired. If the Ith size is not present any more, this means an

appropriate size cannot be selected. Hence, if it is determined in step S17 that the Ith designated size is not present, exceptional processing is performed. For example, in the table shown in Fig. 22, no fourth smallest size is present in the vertical direction. For this reason, when I = 4, the flow advances to exceptional processing. One of the three measures described with reference to Figs. 23 to 25 is performed as exceptional processing.

When the Ith designated size is selected in step S16, the flow advances from step S17 to step S18. In step S18, it is determined whether the irradiation field area input in step S11 falls within the selected designated size. If YES in step S18, the flow advances to step S22 to determine the coordinates of the designated size (obtain layout coordinate determination) such that the center of the selected designated size matches the center of the recognized irradiation field area, and processing is ended.

If NO in step S18, the flow advances to step S19 to calculate the outstretch margin. Fig. 29 is a view for explaining outstretch margin calculation of this embodiment. Generally, the irradiation field boundary of the recognized irradiation field is vague. The area effective for diagnosis is near the central portion of the image. For this reason, even when a small portion of the vicinity of the irradiation field area is excluded, the area effective for diagnosis is not excluded. As shown in

Fig. 29, as long as the vertical and horizontal outstretch portions (margins) with respect to the film size (designated size) fall within predetermined ranges, respectively, it is determined that the irradiation field area can be matched with the horizontal or vertical size of the designated size. This also applies to a case wherein the irradiation field area stretches out only in the horizontal direction or only in the vertical direction. In this embodiment, in step S19, the size of the outstretch portion is calculated. In step S20, it is determined whether that size falls within 5% the film length in the outstretch direction (the vertical outstretch portion is compared with the vertical film length, and the horizontal outstretch portion is compared with the horizontal film length). If YES in step S20, the flow advances to step S23 to make the irradiation field area smaller than the irradiation field area calculation result such that the irradiation field area falls within the designated size. The flow advances to step S22 to determine the layout coordinates.

If NO in step S20, the flow advances to step S21 to increment the variable I to check the next designated size, and the flow returns to step S16.

In the above way, the irradiation field area layout calculation section 1203 selects an appropriate size for output on the basis of the recognized irradiation field area,



and determines the layout position of the irradiation field area in the selected designated size.

Figs. 30A to 30C are views for explaining the display method on the display section 1206. Fig. 30A shows a state wherein the reduced images of an irradiation field area frame 2001, film frame 2002, and sensor area (entire image area) 2003 are overlaid and displayed on the basis of the calculated layout. In Figs. 30B and 30C, the reduced images of the irradiation field area frame 2001, sensor area 2003, and an output image area frame 2004 are overlaid and displayed. The output image area frame 2004 represents the output image area determined by irradiation field area layout calculation described with reference to Fig. 28. No film frame is displayed in Figs. 30B and 30C. In the system of this embodiment, one of the display forms shown in Figs. 30A to 30C can be arbitrarily selected.

As has been described above, according to the fourth embodiment of the present invention, the effective portion of an image can be output with an appropriate size using a commercially available film having a predetermined size or a commercially available image viewer having a predetermined maximum allowable size. Hence, an image can be formed on an existing medium or viewer without damaging the information. As a consequence, since no custom-made film, printer, or image viewer need be used, the cost effect for users becomes large.

In this embodiment, for easier implementation and descriptive convenience, most processing operations are realized by software. However, they can also be realized by hardware without departing from the scope or spirit of the present invention.

The present invention may be applied to a system constituted by a plurality of devices (e.g., a host computer, an interface device, a reader, a printer, and the like) or an apparatus comprising a single device (e.g., a copying machine, a facsimile apparatus, or the like).

The object of the present invention is realized even by supplying a storage medium storing software program codes for realizing the functions of the above-described embodiments to a system or an apparatus, and causing the computer (or a CPU or an MPU) of the system or the apparatus to read out and execute the program codes stored in the storage medium.

In this case, the program codes read out from the storage medium realize the functions of the above-described embodiments by themselves, and the storage medium storing the program codes constitutes the present invention.

As a storage medium for supplying the program codes, a floppy disk, a hard disk, an optical disk, a magnetooptical disk, a CD-ROM, a CD-R, a magnetic tape, a nonvolatile memory card, a ROM, or the like can be used.

The functions of the above-described embodiments are

realized not only when the readout program codes are executed  
by the computer but also when the OS (Operating System)  
running on the computer performs part or all of actual  
processing on the basis of the instructions of the program  
5 codes.

The functions of the above-described embodiments are  
also realized when the program codes read out from the storage  
medium are written in the memory of a function expansion board  
inserted into the computer or a function expansion unit  
10 connected to the computer, and the CPU of the function  
expansion board or function expansion unit performs part or  
all of actual processing on the basis of the instructions  
of the program codes.

As many apparently widely different embodiments of the  
15 present invention can be made without departing from the  
spirit and scope thereof, it is to be understood that the  
invention is not limited to the specific embodiments thereof  
except as defined in the appended claims.

WHAT IS CLAIMED IS:

1. An image processing apparatus for processing image information obtained by exposing radiation on an object, comprising:

5 generation means for generating observation area information indicating an observation area of the object; input means for inputting a size of an output medium; and

10 determination means for determining an output method of the observation area on the basis of the size of the output medium.

2. The apparatus according to claim 1, wherein said radiation is X-ray.

15 3. The apparatus according to claim 1, wherein said observation area is an area where said radiation is exposed.

20 4. The apparatus according to claim 1, further comprising output mode input means for inputting an output mode representing an output format of the observation area.

25 5. The apparatus according to claim 4, wherein said output mode includes a mode in which the observation area is divided into a plurality of areas and the plurality of areas are formed on a plurality of output media.

6. The apparatus according to claim 4, wherein said

output mode includes a mode in which the observation area is reduced and the reduced area is formed on a single output medium.

- 5     7.     An image processing method for processing image information obtained by exposing radiation on an object, comprising:

         the generation step of generating observation area information indicating an observation area of the object;

- 10           the input step of inputting a size of an output medium; and

         the determination step of determining an output method of the observation area on the basis of the size of the output medium.

15

8.     A storage medium storing a control program for causing a computer to process image information obtained by exposing radiation on an object, said control program comprising:

- 20           a code of the generation step of generating observation area information indicating an observation area of the object;

         a code of the input step of inputting a size of an output medium; and

- 25           a code of the determination step of determining an output method of the observation area on the basis of the size of the output medium.

9. An image processing system for processing an image signal obtained by electronically converting an input image and outputting the image signal, characterized by comprising:

5           output mode input means for inputting an output mode representing an output format of an observation area on an output medium;

          input means for inputting a size of an effective image area of the output medium; and

10           determination means for determining an output method of the observation area on the basis of the observation area and contents input by said output mode input means and said input means.

10. The system according to claim 9, characterized in  
15   that the image is obtained by irradiating an object with an X-ray generated by an X-ray generation apparatus, and

          the observation area is set on the basis of an X-ray irradiation stop of said X-ray generation apparatus.

11. The system according to claim 10, characterized in  
20   that the observation area is set on the basis of an irradiation area of the X-ray generated by said X-ray generation apparatus, which is extracted from the image.

12. The system according to claim 9, characterized in  
25   that the observation area is set on the basis of a to-be-photographed portion in the image.

13. The system according to claim 9, characterized in

that said determination means determines, on the basis of an aspect ratio of the observation area, a type of output medium to be used to output the observation area.

14. The system according to claim 9, characterized in that said output mode input means has at least a life-size output mode in which the observation area is output in an actual size, a reduction output mode in which the observation area is reduced and output, an image extraction output mode in which a predetermined area is extracted from the observation area and output, and a multiple output mode in which the observation area is divided into a plurality of division areas and output to a plurality of output media.

15. The system according to claim 9, characterized in that when a multiple output mode is input by said output mode input means, and the observation area does not fall within the effective image area of the output medium, said determination means determines to divide each image corresponding to a size of the effective image area including boundaries of the observation area and output the divided images to a plurality of output media.

16. An image processing method of processing an image signal obtained by electronically converting a photographed image and outputting the image signal, characterized by comprising:

the output mode input step of inputting an output mode representing an output format of an observation area on an

output medium;

the input step of inputting a size of an effective image area of the output medium; and

the determination step of determining an output  
5 method of the observation area on the basis of the observation area and contents input in the output mode input step and the input step.

17. The method according to claim 16, characterized in that the image is obtained by irradiating an object with  
10 an X-ray generated by an X-ray generation apparatus, and

the observation area is set on the basis of an X-ray irradiation stop of said X-ray generation apparatus.

18. The method according to claim 17, characterized in that the observation area is set on the basis of an  
15 irradiation area of the X-ray generated by said X-ray generation apparatus, which is extracted from the image.

19. The method according to claim 16, characterized in that the observation area is set on the basis of a to-be-photographed portion in the image.

20. The method according to claim 16, characterized in that the determination step comprises determining, on the basis of an aspect ratio of the observation area, a type of output medium to be used to output the observation area.

21. The method according to claim 16, characterized in  
25 that the output mode input step allows to input at least one of a life-size output mode in which the observation area



is output in an actual size, a reduction output mode in which the observation area is reduced and output, an image extraction output mode in which a predetermined area is extracted from the observation area and output, and a  
5 multiple output mode in which the observation area is divided into a plurality of division areas and output to a plurality of output media.

22. The method according to claim 16, characterized in that when a multiple output mode is input in the output mode  
10 input step, and the observation area does not fall within the effective image area of the output medium, the determination step comprises determining to divide each image corresponding to a size of the effective image area including boundaries of the observation area and output the  
15 divided images to a plurality of output media.

23. A computer-readable memory which stores program codes for controlling an image processing system for processing an image signal obtained by electronically converting a photographed image and outputting the image  
20 signal, characterized by comprising:

a program code of the output mode input step of inputting an output mode representing an output format of an observation area on an output medium;

a program code of the input step of inputting a size  
25 of an effective image area of the output medium; and  
a program code of the determination step of

determining an output method of the observation area on the basis of the observation area and contents input in the output mode input step and the input step.

24. A photographing system for processing an image  
5 obtained by photographing and outputting the image,  
characterized by comprising:

photographing means for photographing an image;

output mode input means for inputting an output mode  
representing an output format of an observation area on an  
10 output medium;

input means for inputting a size of an effective image  
area of the output medium; and

determination means for determining an output method  
of the observation area on the basis of the observation area  
15 and contents input by said output mode input means and said  
input means.

25. The system according to claim 24, characterized in  
that said photographing means comprises an X-ray  
photographing apparatus having an X-ray generation  
20 apparatus and an X-ray detection apparatus, and

the observation area is set on the basis of an X-ray  
irradiation stop of said X-ray generation apparatus.

26. The system according to claim 25, characterized in  
that the observation area is set on the basis of an  
25 irradiation area of the X-ray generated by said X-ray  
generation apparatus, which is extracted from the image.

27. The system according to claim 24, characterized in that the observation area is set on the basis of a to-be-photographed portion in the image.

28. The system according to claim 24, characterized in  
5 that said determination means determines, on the basis of an aspect ratio of the observation area, a type of output medium to be used to output the observation area.

29. The system according to claim 24, characterized in  
10 that said output mode input means has at least a life-size output mode in which the observation area is output in an actual size, a reduction output mode in which the observation area is reduced and output, an image extraction output mode in which a predetermined area is extracted from the observation area and output, and a multiple output mode  
15 in which the observation area is divided into a plurality of division areas and output to a plurality of output media.

30. The system according to claim 24, characterized in that when a multiple output mode is input by said output mode input means, and the observation area does not fall  
20 within the effective image area of the output medium, said determination means determines to divide each image corresponding to a size of the effective image area including boundaries of the observation area and output the divided images to a plurality of output media.

25 31. A control method for a photographing system for processing an image obtained by photographing and

outputting the image, characterized by comprising:

the photographing step of photographing an image;

the output mode input step of inputting an output mode  
representing an output format of an observation area on an  
5 output medium;

the input step of inputting a size of an effective  
image area of the output medium; and

the determination step of determining an output  
method of the observation area on the basis of the  
10 observation area and contents input in the output mode input  
step and the input step.

32. The method according to claim 31, characterized in  
that the photographing step comprises photographing the  
image using an X-ray photographing apparatus having an  
15 X-ray generation apparatus and an X-ray detection apparatus,  
and

the observation area is set on the basis of an X-ray  
irradiation stop of said X-ray generation apparatus.

33. The method according to claim 32, characterized in  
20 that the observation area is set on the basis of an  
irradiation area of the X-ray generated by said X-ray  
generation apparatus, which is extracted from the image.

34. The method according to claim 31, characterized in  
that the observation area is set on the basis of a  
25 to-be-photographed portion in the image.

35. The method according to claim 31, characterized in

that the determination step comprises determining, on the basis of an aspect ratio of the observation area, a type of output medium to be used to output the observation area.

36. The method according to claim 31, characterized in  
5 that the output mode input step allows to input at least one of a life-size output mode in which the observation area is output in an actual size, a reduction output mode in which the observation area is reduced and output, an image extraction output mode in which a predetermined area is  
10 extracted from the observation area and output, and a multiple output mode in which the observation area is divided into a plurality of division areas and output to a plurality of output media.

37. The method according to claim 31, characterized in  
15 that when a multiple output mode is input in the output mode input step, and the observation area does not fall within the effective image area of the output medium, the determination step comprises determining to divide each image corresponding to a size of the effective image area  
20 including boundaries of the observation area and output the divided images to a plurality of output media.

38. A computer-readable memory which stores program codes for controlling a photographing system for processing an image obtained by photographing and outputting the image,  
25 characterized by comprising:

a program code of the photographing step of

photographing an image;

a program code of the output mode input step of inputting an output mode representing an output format of an observation area on an output medium;

5 a program code of the input step of inputting a size of an effective image area of the output medium; and

a program code of the determination step of determining an output method of the observation area on the basis of the observation area and contents input in the  
10 output mode input step and the input step.

39. An image processing apparatus characterized by comprising:

acquisition means for specifying a to-be-output area of an image represented by image data as an output image  
15 and acquiring a size of the output image;

selection means for selecting, on the basis of the size of the output image acquired by said acquisition means, one image output size from a plurality of types of image output sizes set in advance;

20 layout determination means for determining a layout of the output image in an output area having the image output size selected by said selection means;

display means for displaying on the basis of a layout state determined by said layout determination means; and

25 change means for changing the layout state of the output image in the output area in accordance with an

instruction for changing the layout state displayed by said display means.

40. The apparatus according to claim 39, characterized in that said display means reduces the output area and the  
5 output image and displays the output image in the layout state determined by said layout determination means.

41. The apparatus according to claim 39, characterized in that said display means overlays, in accordance with the layout state, an image obtained by reducing an image  
10 representing the output area on an image obtained by reducing the image represented by the image data and displays the layout state.

42. The apparatus according to claim 39, characterized by further comprising output means for outputting the  
15 output image to an output medium having the output area on the basis of a final layout state determined by said layout determination means and said change means.

43. The apparatus according to claim 39, characterized in that said selection means selects an output area with  
20 an image output size having a minimum residual area, within which the entire output image falls.

44. The apparatus according to claim 43, characterized in that said selection means selects an output area having an output size assuming that the entire output image falls  
25 within the output size as long as a outstretch amount of the output image from the output\_size falls within a

predetermined range, and removes the outstretch portion from the output image.

45. The apparatus according to claim 39, characterized by further comprising reduction means for, when no  
5 appropriate output area is obtained by said selection means, reducing the output image such that the output image falls within a predetermined output area.

46. The apparatus according to claim 39, characterized by further comprising deletion means for, when no  
10 appropriate output area is obtained by said selection means, deleting a outstretch portion of the output image from a predetermined output area.

47. The apparatus according to claim 39, characterized by further comprising extraction means for, when no  
15 appropriate output area is obtained by said selection means, displaying the output image overlaid on a predetermined output area and extracting a desired area from the output image by user's operation.

48. The apparatus according to claim 39, characterized  
20 in that said display means displays the entire image represented by the image data, a range of the output image, and the output area in an identifiable state.

49. The apparatus according to claim 39, characterized in that said display means displays the entire image  
25 represented by the image data, the output area specified by said acquisition means, and an output area to be actually



output in an identifiable state.

50. The apparatus according to claim 39, characterized in that the image data represents an X-ray digital image obtained by X-ray irradiation, and

5 the output image specified by said acquisition means is an image of an area specified by recognizing an irradiation field in the X-ray digital image.

51. The apparatus according to claim 50, characterized in that the plurality of types of output sizes correspond  
10 to a plurality of film sizes, respectively, and

said apparatus further comprises output means for extracting the output image and outputting the output image to a film having the output area on the basis of a final layout state determined by said layout determination means  
15 and said change means.

52. The apparatus according to claim 45, characterized by further comprising

output means for outputting the output image to an output medium having the output area on the basis of a final  
20 layout state determined by said layout determination means and said change means, and

addition means for, when the output image is reduced by said reduction means, adding one of a symbol and a character representing reduction.

25 53. An image processing method characterized by comprising:

the acquisition step of specifying a to-be-output area of an image represented in image data as an output image and acquiring a size of the output image;

the selection step of selecting, on the basis of the  
5 size of the output image acquired in the acquisition step, one image output size from a plurality of types of image output sizes set in advance;

the layout determination step of determining a layout  
10 of the output image in an output area having the image output size selected in the selection step;

the display step of displaying on the basis of a layout state determined in the layout determination step; and

the change step of changing the layout state of the  
15 output image in the output area in accordance with an instruction for changing the layout state displayed in the display step.

54. The method according to claim 53, characterized in that the display step comprises reducing the output area and the output image and displaying the output image in the  
20 layout state determined in the layout determination step.

55. The method according to claim 53, characterized in that the display step comprises overlaying, in accordance with the layout state, an image obtained by reducing an image representing the output area on an image obtained by  
25 reducing the image represented by the image data and displaying the layout state.

56. The method according to claim 53, characterized by further comprising the output step of outputting the output image to an output medium having the output area on the basis of a final layout state determined in the layout determination step and the change step.

57. The method according to claim 53, characterized in that the selection step comprises selecting an output area with an image output size having a minimum residual area, within which the entire output image falls.

58. The method according to claim 57, characterized in that the selection step comprises selecting an output area having an output size assuming that the entire output image falls within the output size as long as a outstretch amount of the output image from the output size falls within a predetermined range, and removing the outstretch portion from the output image.

59. The method according to claim 53, characterized by further comprising the reduction step of, when no appropriate output area is obtained in the selection step, reducing the output image such that the output image falls within a predetermined output area.

60. The method according to claim 53, characterized by further comprising the deletion step of, when no appropriate output area is obtained in the selection step, deleting a outstretch portion of the output image from a predetermined output area.

61. The method according to claim 53, characterized by further comprising the extraction step of, when no appropriate output area is obtained in the selection step, displaying the output image overlaid on a predetermined  
5 output area and extracting a desired area from the output image by user's operation.

62. The method according to claim 53, characterized in that the display step comprises displaying the entire image represented by the image data, a range of the output image,  
10 and the output area in an identifiable state.

63. The method according to claim 53, characterized in that the display step comprises displaying the entire image represented by the image data, the output area specified in the acquisition step, and an output area to be actually  
15 output in an identifiable state.

64. The method according to claim 53, characterized in that the image data represents an X-ray digital image obtained by X-ray irradiation, and

the output image specified in the acquisition step  
20 is an image of an area specified by recognizing an irradiation field in the X-ray digital image.

65. The method according to claim 64, characterized in that the plurality of types of output sizes correspond to a plurality of film sizes, respectively, and

25 the method further comprises the output step of extracting the output image and outputting the output image

to a film having the output area on the basis of a final layout state determined in the layout determination step and the change step.

66. The method according to claim 59, characterized by  
5 further comprising

the output step of outputting the output image to an output medium having the output area on the basis of a final layout state determined in the layout determination step and the change step, and

10 the addition step of, when the output image is reduced in the reduction step, adding one of a symbol and a character representing reduction.

67. A storage medium which storing a control program for causing a computer to control an output image size,  
15 characterized in that the control program comprises:

a code of the acquisition step of specifying a to-be-output area of an image represented in image data as an output image and acquiring a size of the output image;

a code of the selection step of selecting, on the basis  
20 of the size of the output image acquired in the acquisition step, one image output size from a plurality of types of image output sizes set in advance;

a code of the layout determination step of determining a layout of the output image in an output area  
25 having the image output size selected in the selection step;

a code of the display step of displaying on the basis

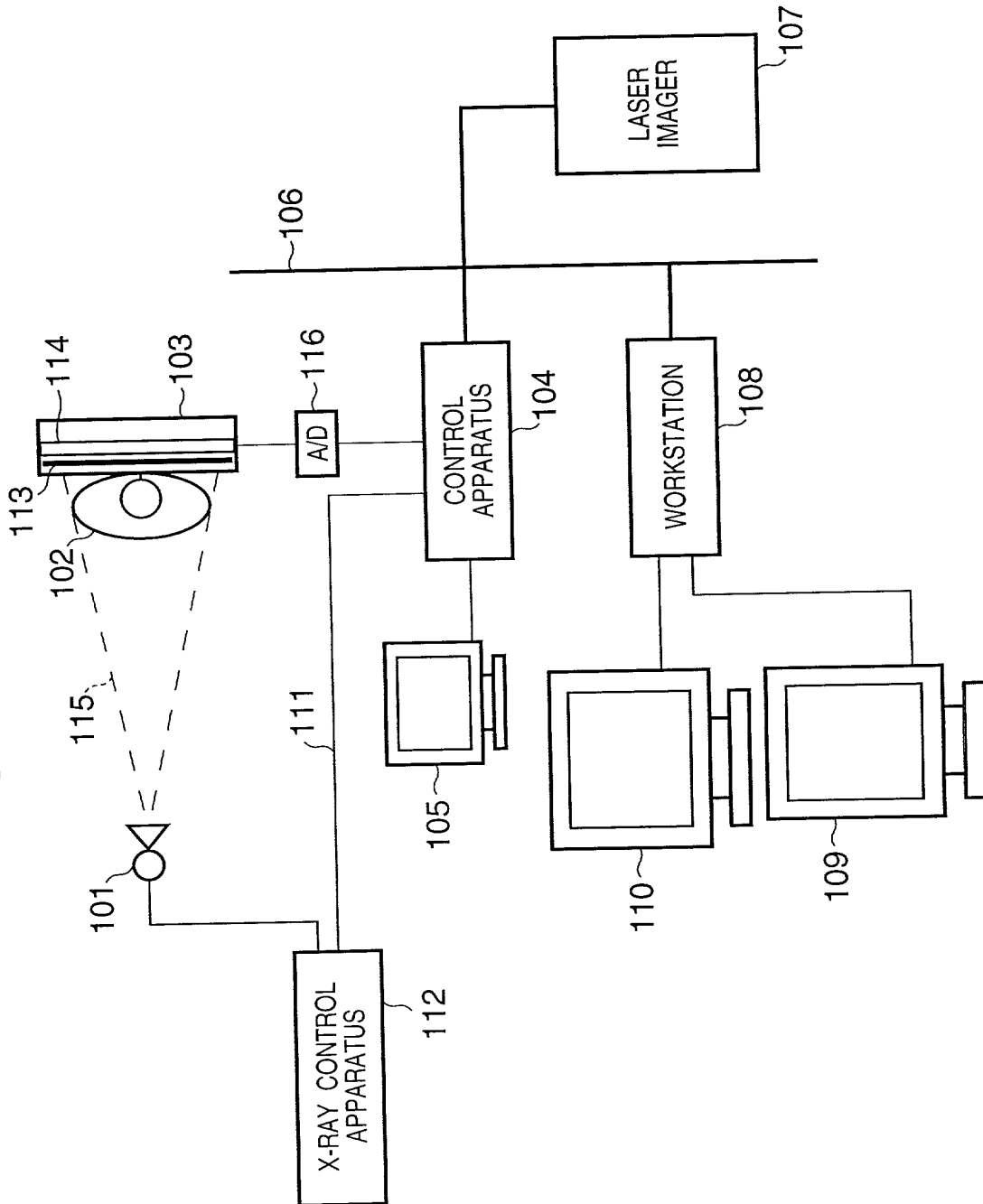
of a layout state determined in the layout determination step; and

a code of the change step of changing the layout state of the output image in the output area in accordance with an instruction for changing the layout state displayed in the display step.

# ABSTRACT OF THE DISCLOSURE

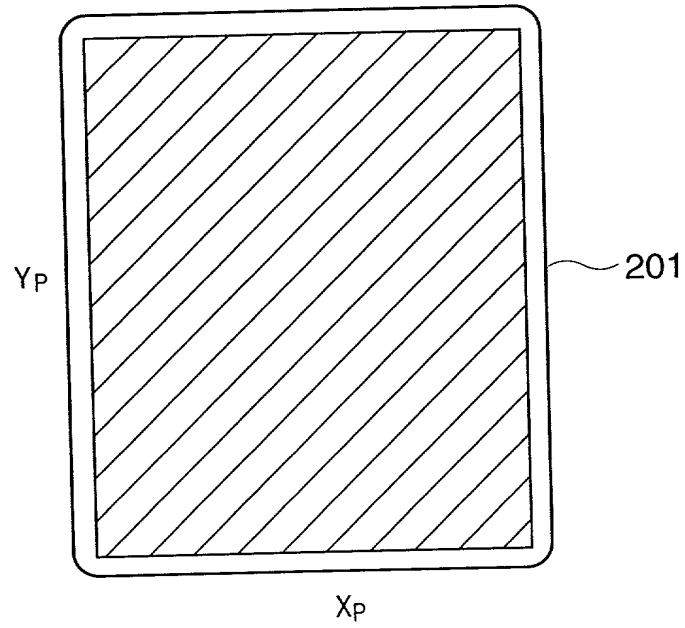
This invention has as its object to provide an image processing system and a control method for the system, a photographing system and a control method for the system, and a computer-readable memory, which can efficiently photograph without any increase in X-ray dose for a person to be examined. To achieve this object, an output mode input section inputs an output mode representing the output format of an observation area as a to-be-output area in an image to an output medium. An output medium size input section inputs the size of the effective image area of the output medium. The output determination section determines the output method of the observation area on the basis of the observation area and contents input by the input sections.

FIG. 1

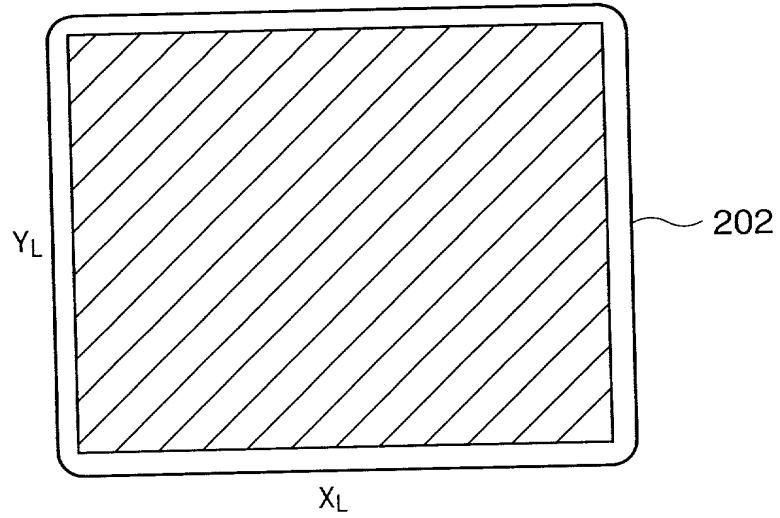




**FIG. 2**



**FIG. 3**



**FIG. 4**

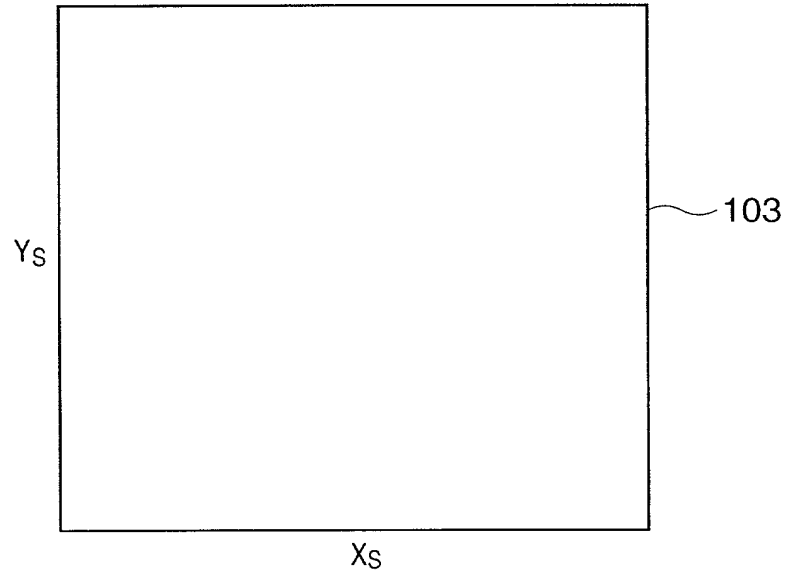


FIG. 5

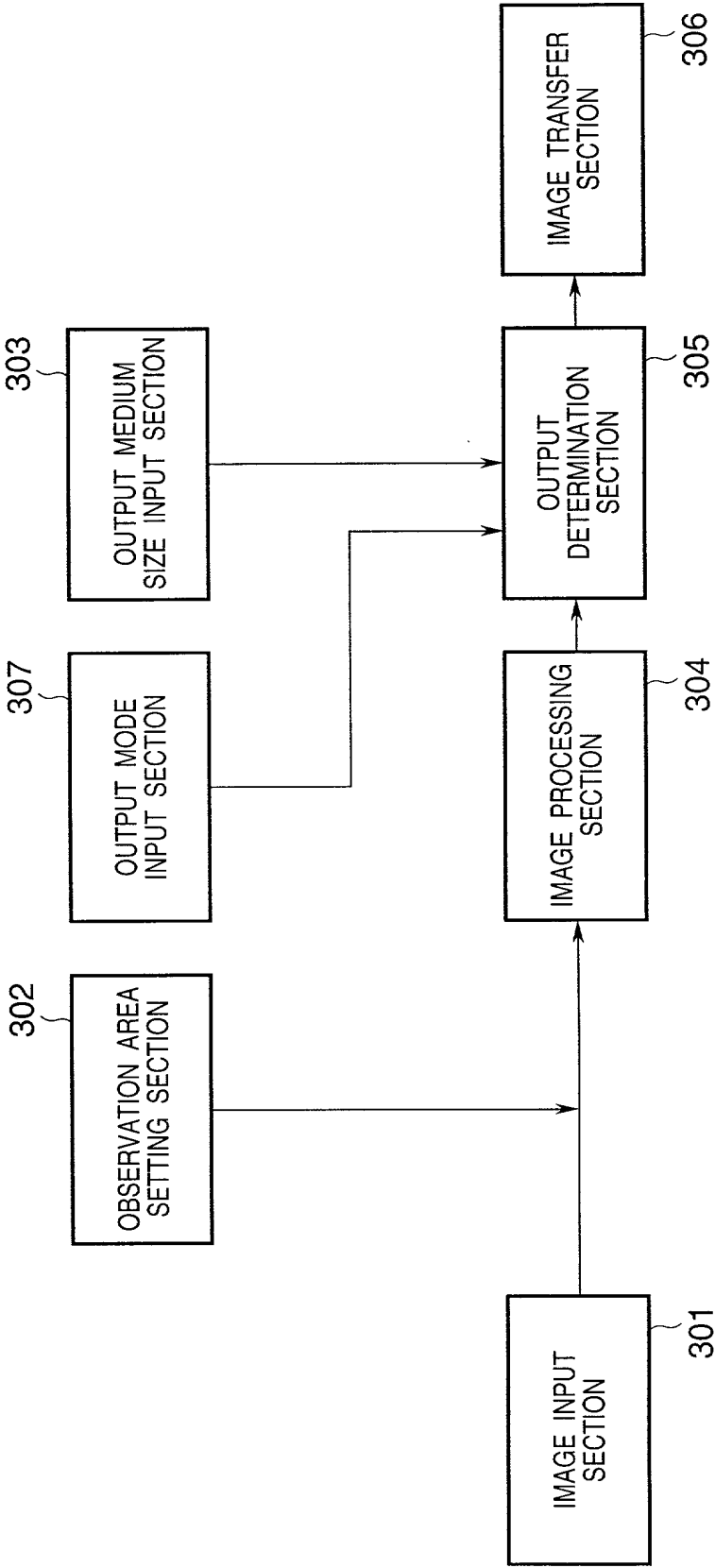
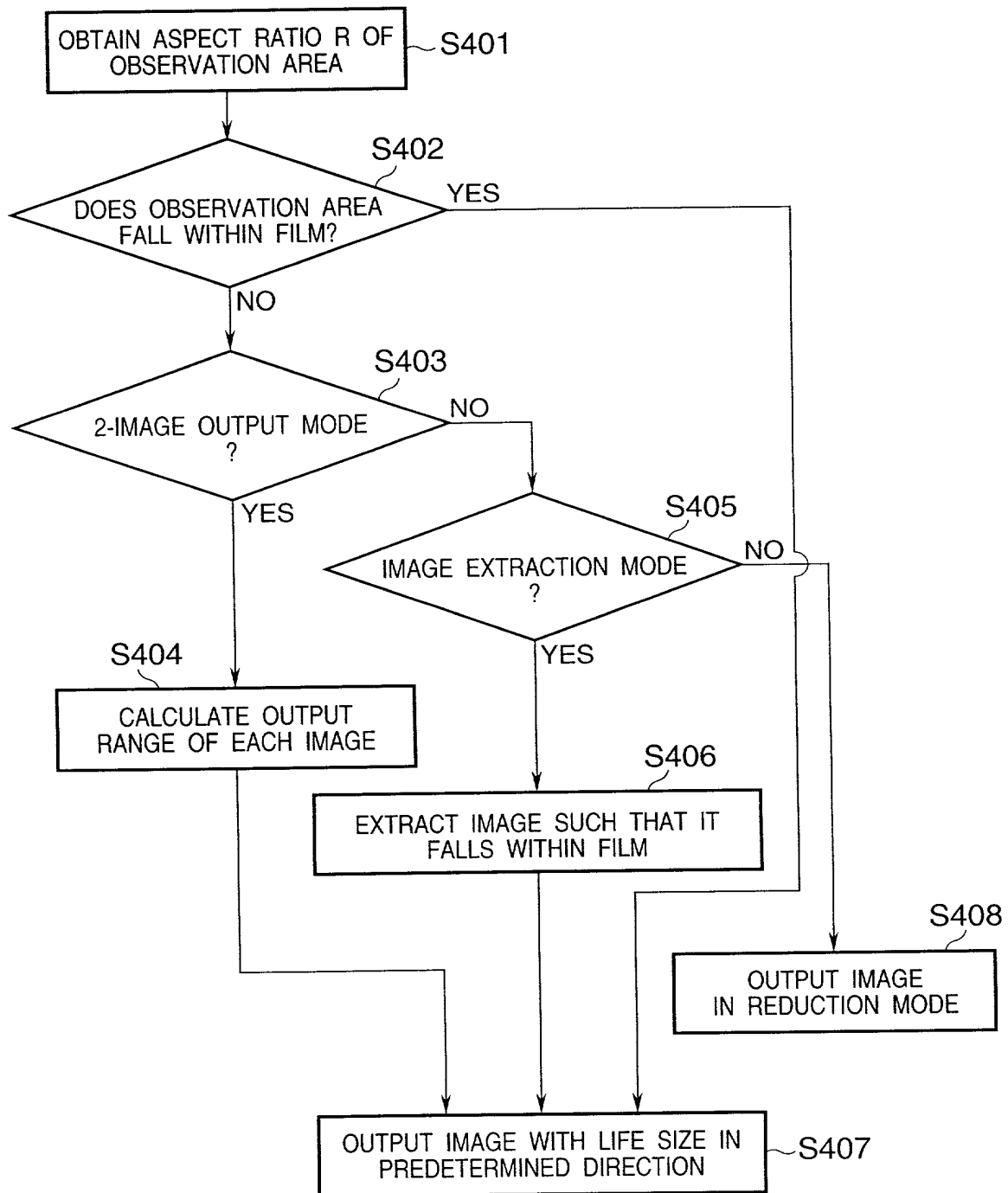
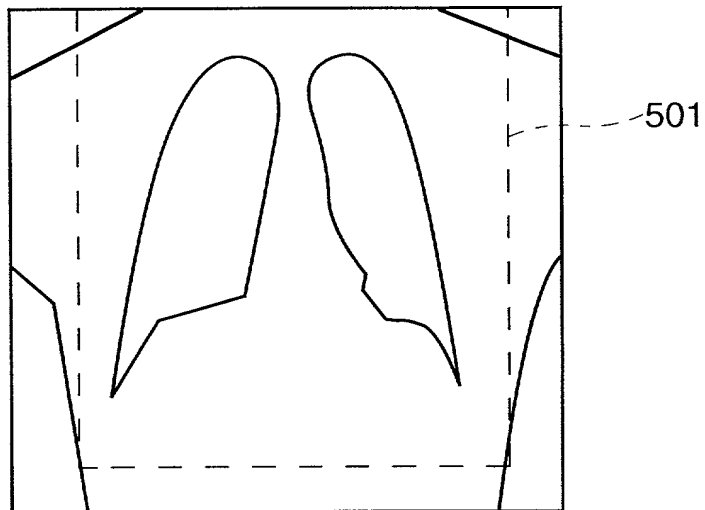


FIG. 6

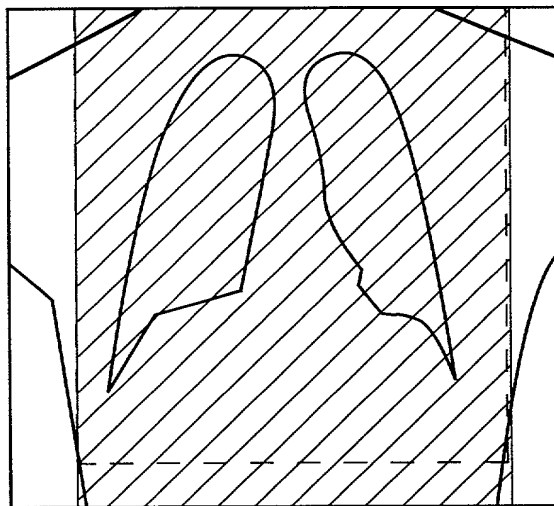


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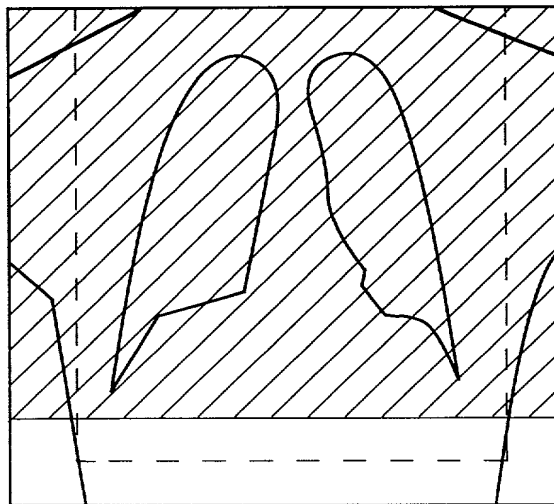
**FIG. 7**



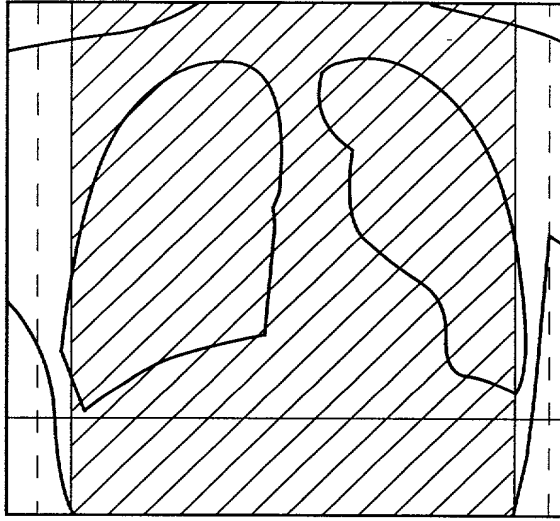
**FIG. 8**



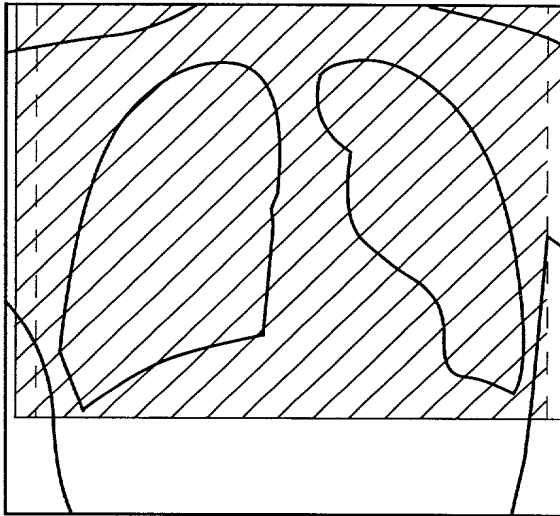
**FIG. 9**



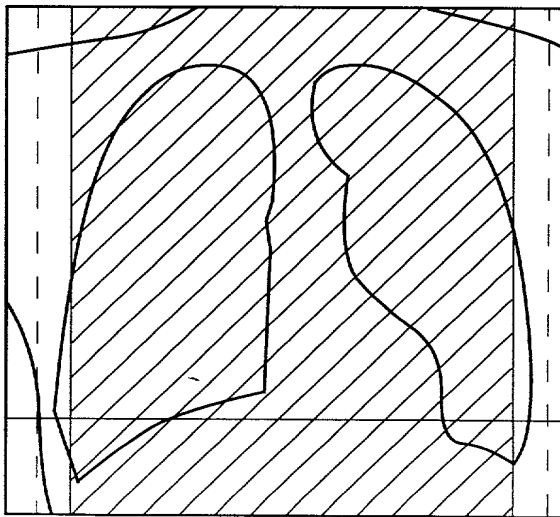
**FIG. 10**



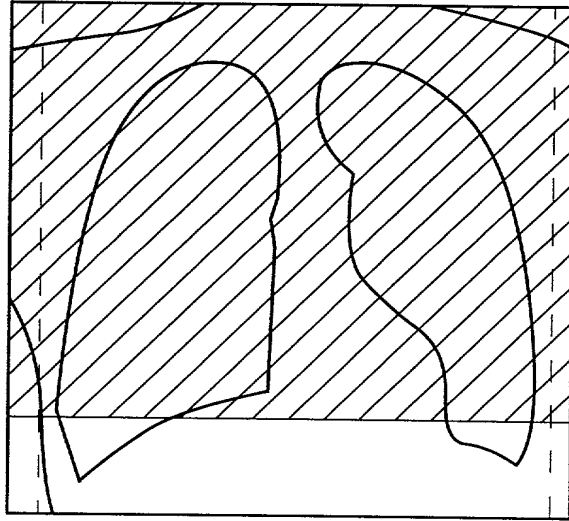
**FIG. 11**



**FIG. 12**



**FIG. 13**



**FIG. 14**

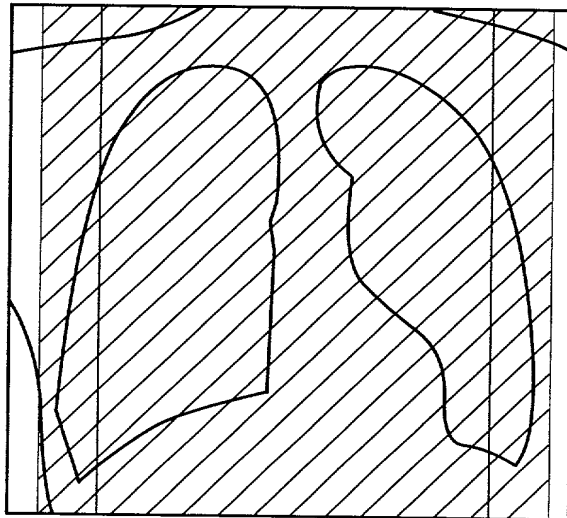
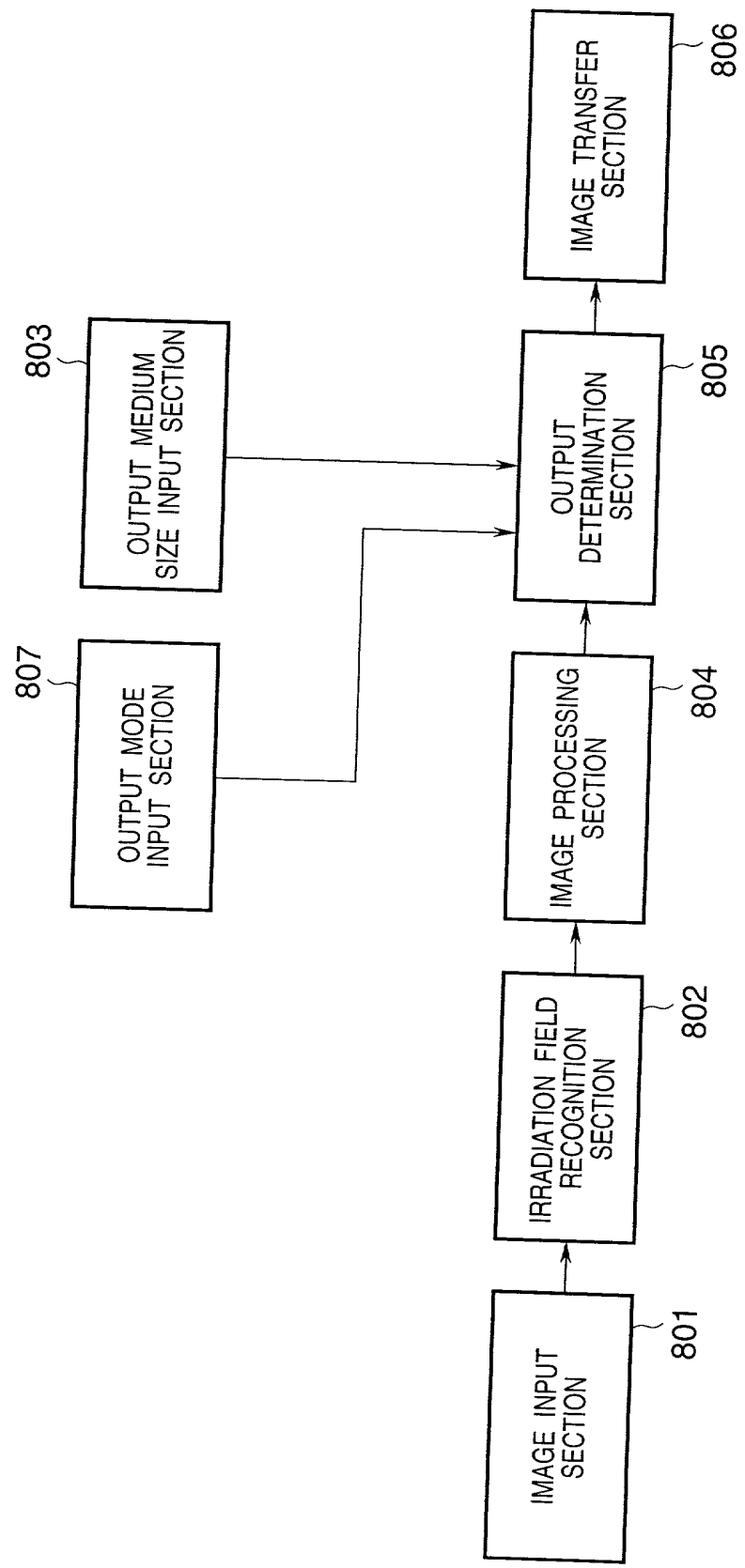
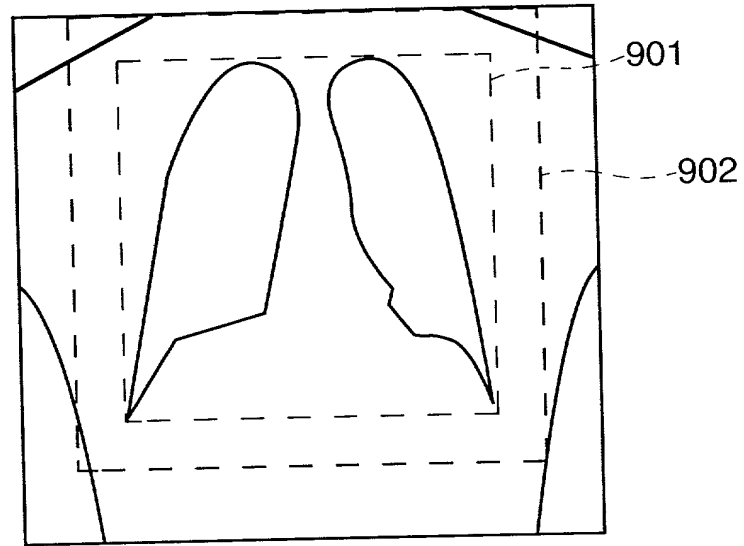


FIG. 15





**FIG. 16**



**FIG. 17**

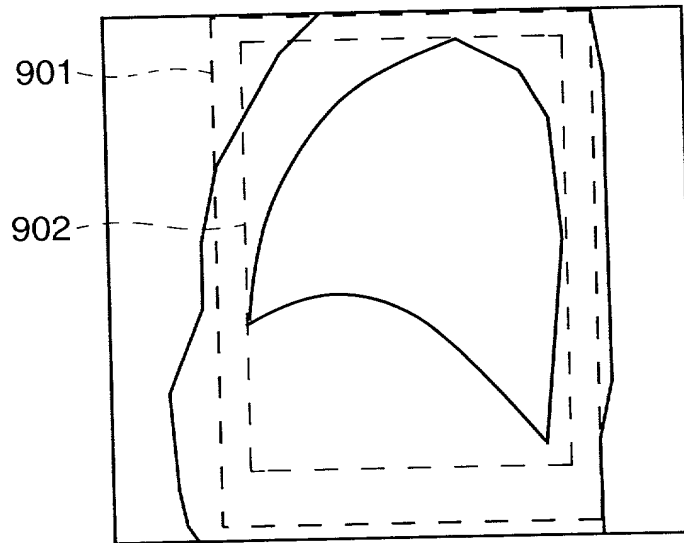
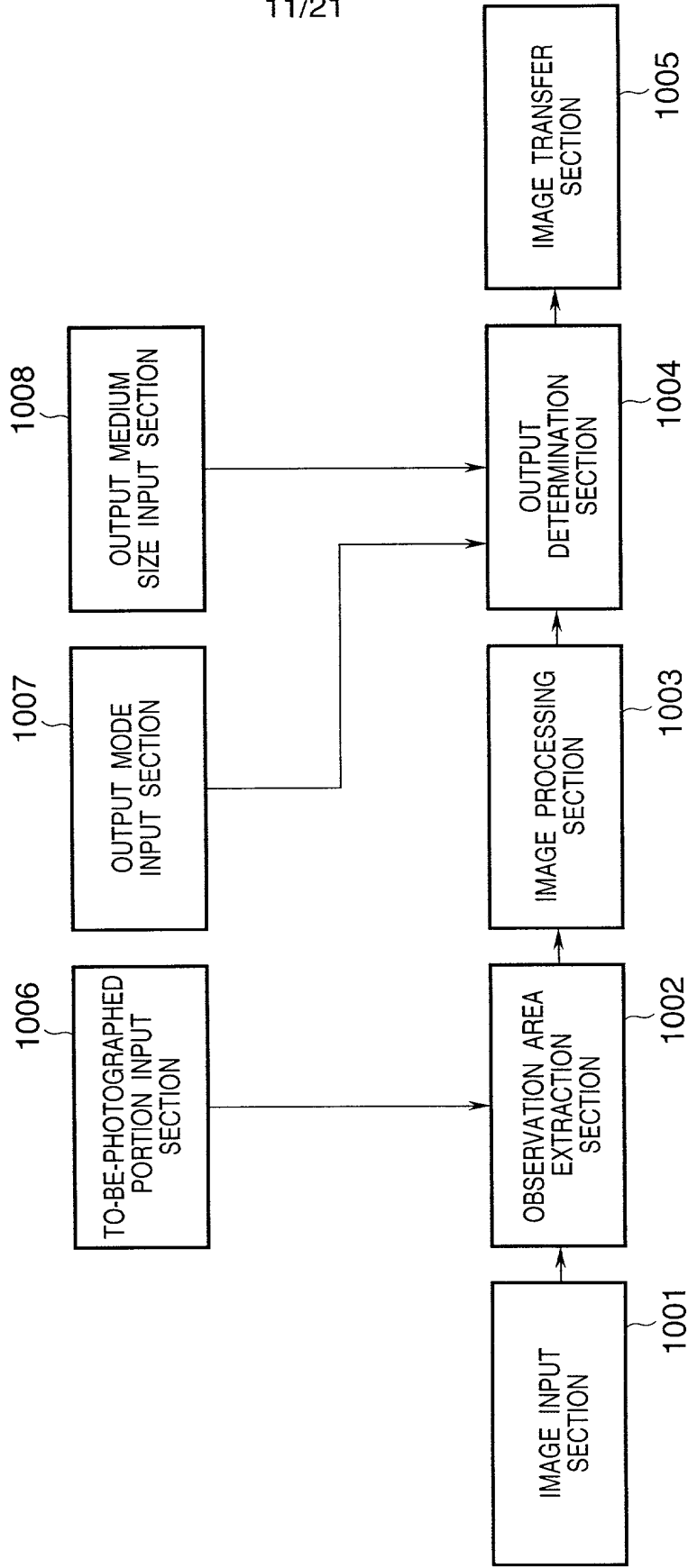
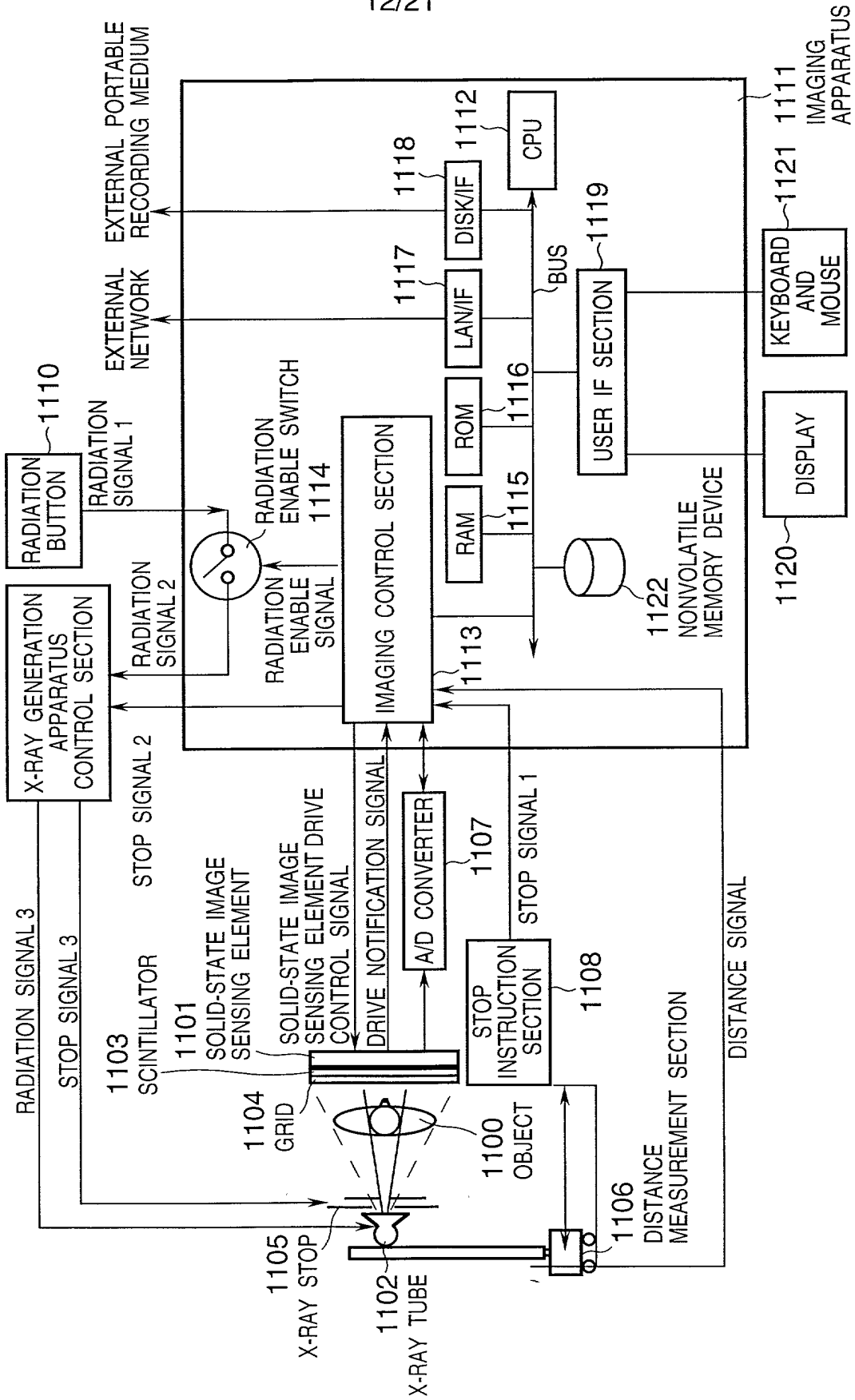


FIG. 18

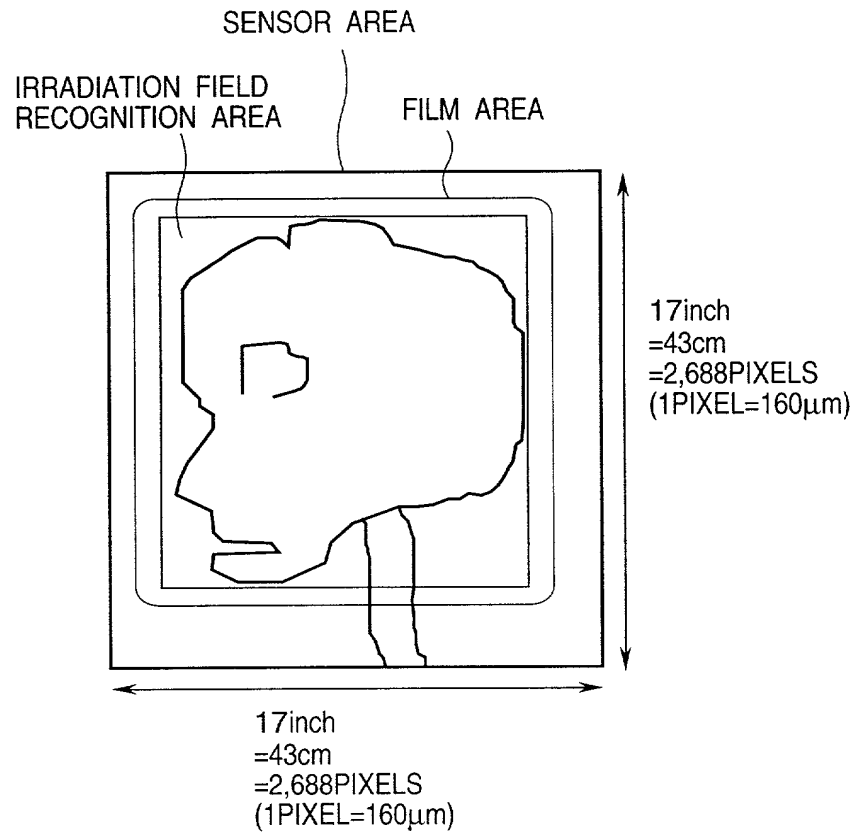


**FIG. 19**



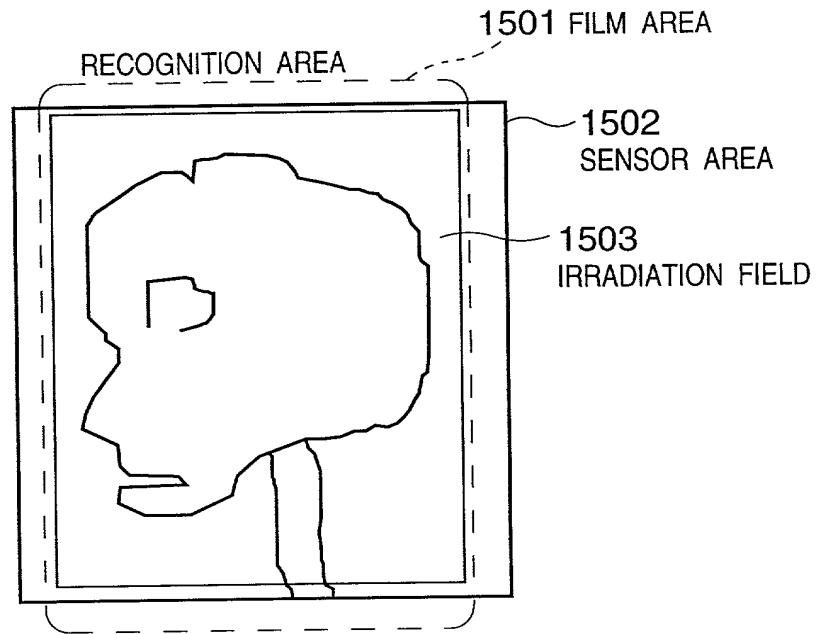
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```
graph TD
    Input[PHOTOGRAPHED IMAGE] --> 1201[IRRADIATION FIELD RECOGNITION SECTION]
    1201 -- "OUTPUT SIZES (PLURALITY)" --> 1203[IRRADIATION FIELD AREA LAYOUT CALCULATION SECTION]
    1201 -- "ROTATION/REVERSAL DESIGNATION VALUES" --> 1204[DISPLAY IMAGE ROTATION/REVERSAL SECTION]
    1208[TEMPORARY STORAGE SECTION] -- "LAYOUT COORDINATE DETERMINATION VALUES" --> 1203
    1203 -- "ROTATION/REVERSAL DETERMINATION VALUES" --> 1204
    1204 -- "REDUCED DISPLAY IMAGE" --> 1202[DISPLAY IMAGE PROCESSING SECTION]
    1202 --> 1205[OVERLAY SECTION]
    1206[DISPLAY SECTION] -- "OUTSTRETCH NOTIFICATION" --> 1205
    1207[INSTRUCTION SECTION] -- "LAYOUT PROCESSING CHANGE" --> 1205
    1207 -- "ROTATION/REVERSAL CHANGE" --> 1205
    1207 -- "ROTATION/REVERSAL DETERMINATION VALUES" --> 1209
    1209[EXTRACTION SECTION] --> 1210[IMAGE PROCESSING SECTION]
    1210 --> 1211[SENSOR POSITION MARKING SECTION]
    1212[ROTATION/REVERSAL SECTION] -- "ROTATION/REVERSAL DETERMINATION VALUES" --> 1209
    1212 -- "SENSOR POSITION MARKING" --> 1211
    1211 --> 1213[REDUCTION MARKING SECTION (OPTION)]
    1213 --> 1214[OUTPUT SECTION]
    1214 --> Output[OUTPUT PHOTOGRAPHED IMAGE]
```

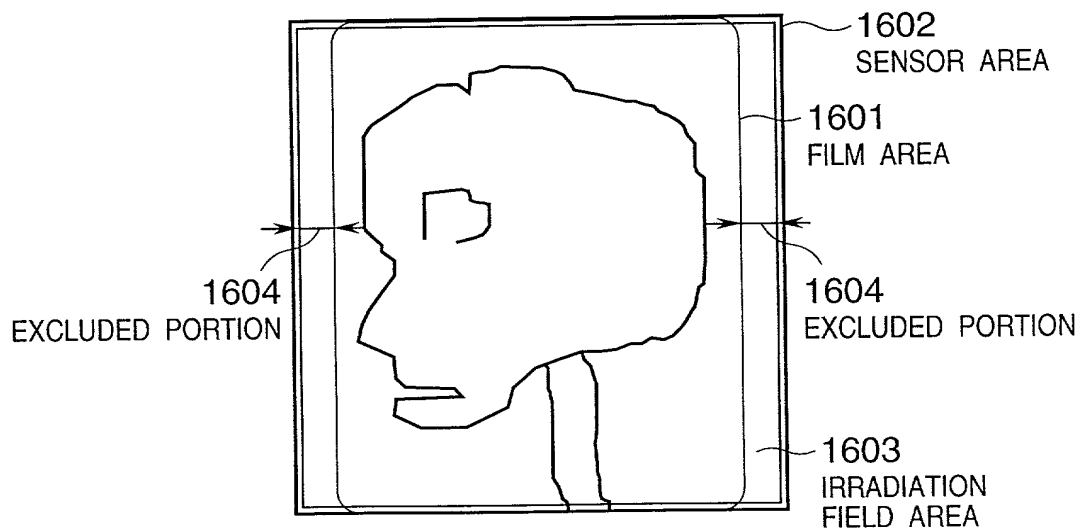
**FIG. 21****FIG. 22**

INCH SIZE (cm)	NAME	LAYOUT CLASSIFICATION	THE NUMBER OF PIXELS
14×17(35×43)	HALF-SIZE PORTRAIT	VERTICAL	2048 2560
17×14(43×35)	HALF-SIZE LANDSCAPE	HORIZONTAL	2560 2048
14×14(35×35)	LARGE SIZE	VERTICAL/HORIZONTAL	2048 2048
10×12(24×30)	1/4-SIZE PORTRAIT	VERTICAL	1768 1450
12×10(30×24)	1/4-SIZE LANDSCAPE	HORIZONTAL	1450 1768

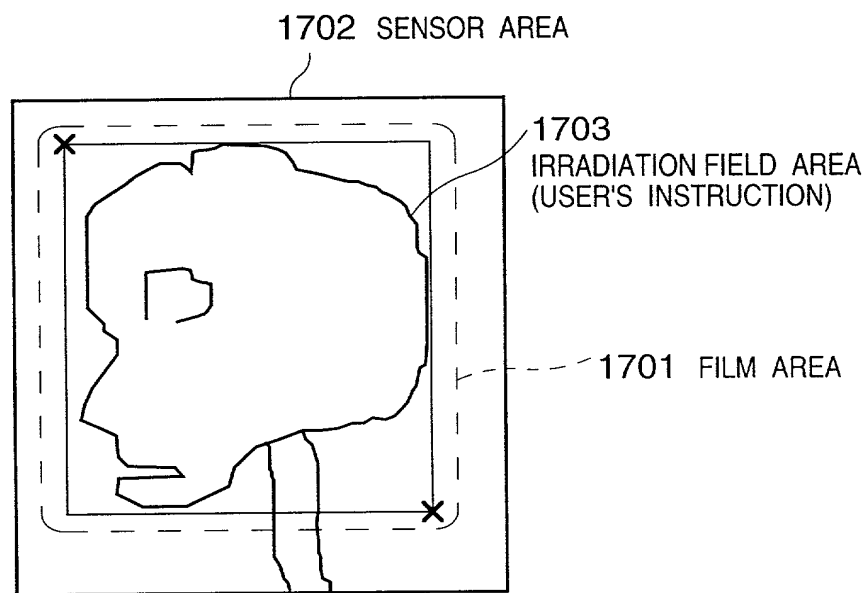
**FIG. 23**



**FIG. 24**

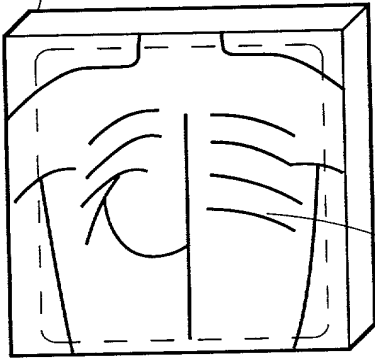


**FIG. 25**



**FIG. 26**

UPPER LEFT PORTION OF SENSOR

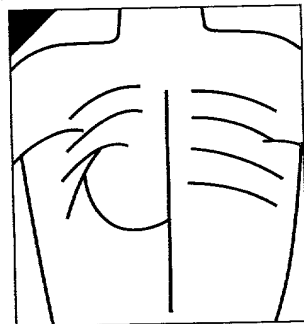


EXTRACTION OR THE LIKE

SENSOR POSITION  
MARKING SECTION

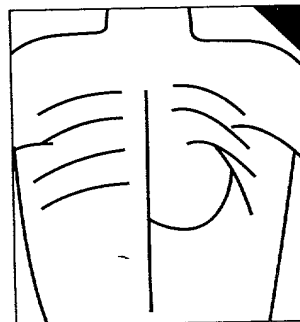
1211

MARK AT UPPER  
LEFT OF SENSOR



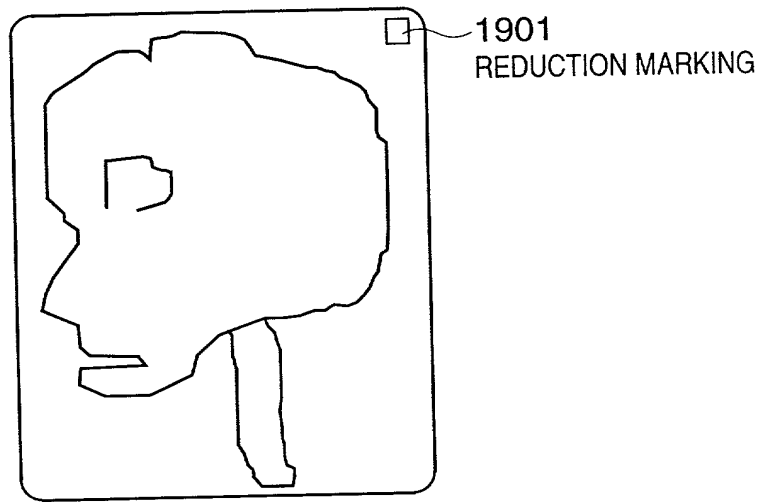
1212

ROTATION/REVERSAL  
SECTION





**FIG. 27**



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**FIG. 28**

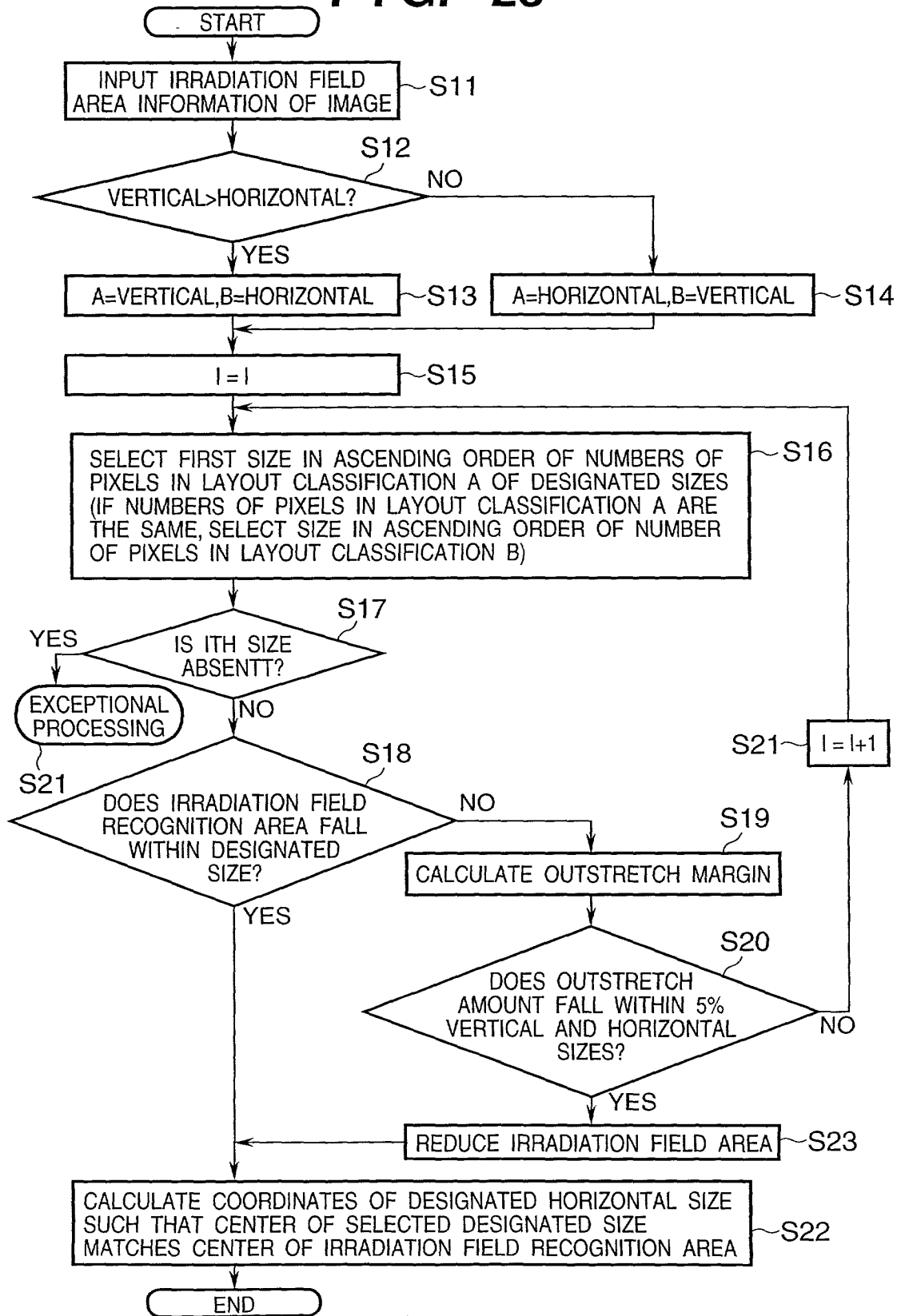
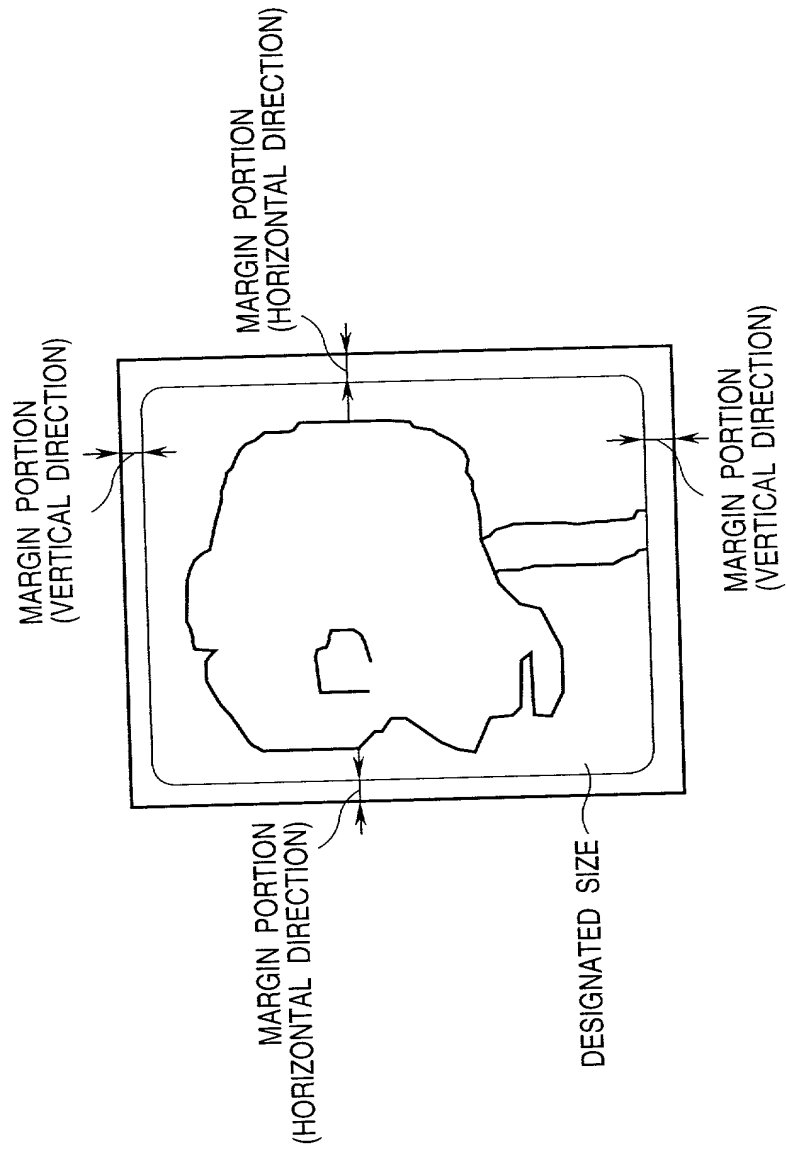
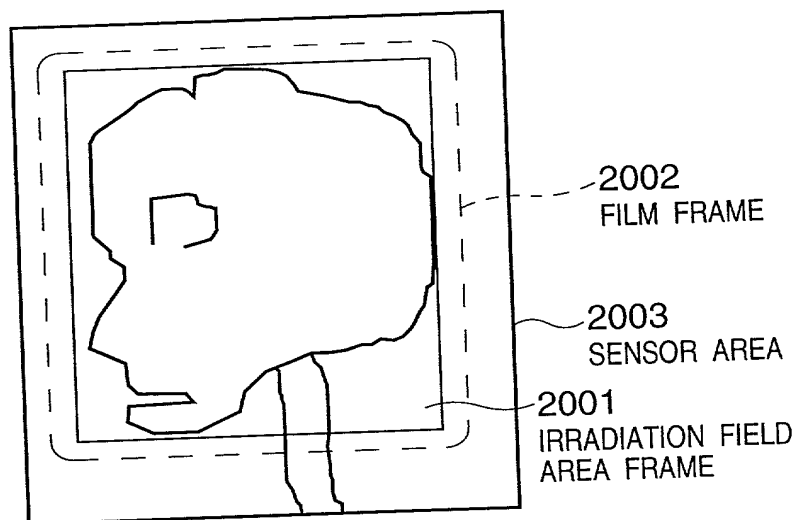


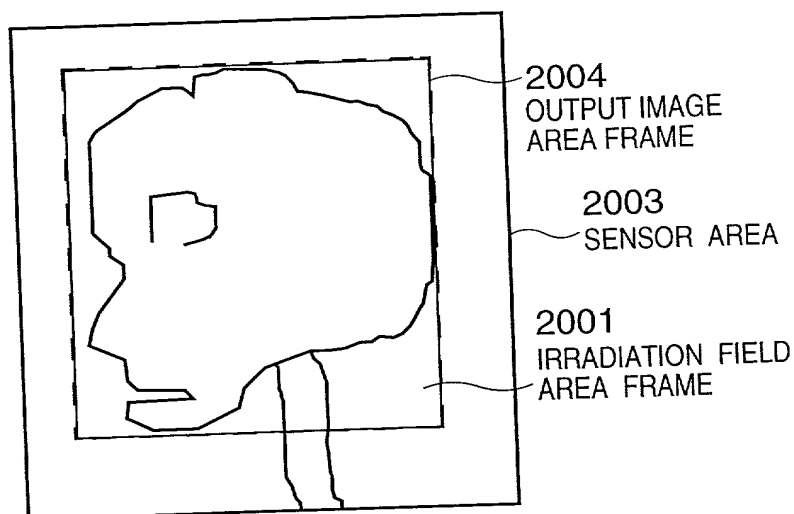
FIG. 29



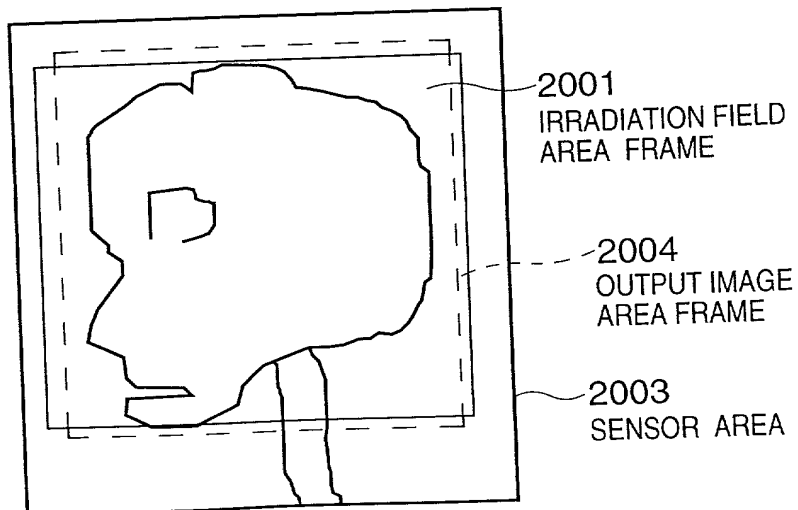
**FIG. 30A**



**FIG. 30B**



**FIG. 30C**



**COMBINED DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATION  
(Page 1)**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled IMAGE PROCESSING APPARATUS AND METHOD, PHOTOGRAPHING SYSTEM, CONTROLLING METHOD FOR THE SYSTEM, AND COMPUTER-READABLE MEMORY

the specification of which ☒ is attached hereto ☐ was filed on \_\_\_\_\_ as United States Application No. or PCT International Application No. \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed
Japan	10-278729	30/September/1998	Yes
Japan	10-279167	30/September/1998	Yes

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Application No.	Filed (Day/Mo./Yr.)	Status (Patented, Pending, Abandoned)
-----------------	---------------------	---------------------------------------

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

**FITZPATRICK, CELLA, HARPER & SCINTO**  
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor TSUKASA SAKO

Inventor's signature \_\_\_\_\_

Date \_\_\_\_\_ Citizen/Subject of Japan

Residence 8-5-402, Motoimaizumi 6-chome, Utsunomiya-shi, Tochigi-ken,  
Japan

Post Office Address c/o CANON KABUSHIKI KAISHA, 30-2, Shimomaruko  
3-chome, Ohta-ku, Tokyo, Japan

COMBINED DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATION  
(Page 2)

Full Name of Second Joint Inventor, if any TAKAHIRO OSHINO

Second Inventor's signature \_\_\_\_\_

Date \_\_\_\_\_ Citizen/Subject of Japan

Residence 11-6-7-305, Motoimaizumi 6-chome, Utsunomiya-shi, Tochigi-  
ken, Japan

Post Office Address c/o CANON KABUSHIKI KAISHA, 30-2, Shimomaruko  
3-chome, Ohta-ku, Tokyo, Japan

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